

**MOTOROLA**

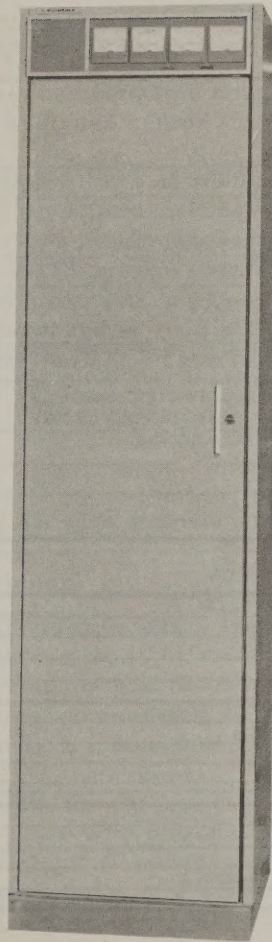
## REPEATER (RT) STATION

FM TWO-WAY RADIO

TONE REMOTE CONTROL

450-470 MHz 120 VAC 50/60 Hz

250/275 W RF POWER



THIS INSTRUCTION MANUAL CONSISTS  
OF THE FOLLOWING PARTS

STATION PACKAGE . . . . .	68P81012E19
RF PACKAGE. . . . .	68P81011E81
CONTROL PACKAGE . . . . .	68P81012E18



**MOTOROLA INC.**

ENGINEERING PUBLICATIONS

1301 E. ALGONQUIN ROAD

**Communications Division**

SCHAUMBURG, ILLINOIS 60172

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68P81011E85  
Issue - O



# MOTOROLA

MODEL CHART  
TONE REMOTE CONTROL REPEATER STATIONS  
450-470 MHz 250/275 W RF POWER

CODE:

☒ = ONE ITEM INCLUDED

\*REPRESENTS A SERIES OF MODELS AND NOT A SPECIFIC MODEL.  
THE SPECIFIC MODEL NUMBER STAMPED ON THE CHASSIS CORRESPONDS WITH A SPECIFIC CARRIER FREQUENCY RANGE.

ITEM	DESCRIPTION	MODEL NUMBER	TRANSMITTER FREQUENCIES	RECEIVER FREQUENCIES	RF POWER	CHANNEL SPACING
*TRE1150AB	RECEIVER, CARRIER SQUELCH	B94MSY-1106AT	1	1	275 W	25 kHz
*TRE1150AF	RECEIVER, "PRIVATE-LINE" TONE-CODED SQUELCH	B94MSY-3106AT	1	1	275 W	25 kHz
*TTE1130AA	TRANSMITTER					
TLE1350A	DRIVER AMPLIFIER					
TPN1089A	POWER SUPPLY					
TLN8847A	"PL" TONE OSCILLATOR					
TCN1094A	REMOTE CONTROL CHASSIS					
TLN1172A	LINE DRIVER MODULE					
TLN1173A	STATION LOGIC MODULE					
TLN1243A	F1 CONTROL MODULE					
TLN1244A	F1-"PL" DISABLE CONTROL MODULE					
TLN1179A	TIME-OUT TIMER					
TLN1180A	SQUELCH GATE MODULE					
TLN1245A	GUARD-TONE DECODER MODULE					
TLN8889A	RECEIVER SHIELD KIT					
TPN1090A	HIGH VOLTAGE POWER SUPPLY					
TLN6943A	TRANSFORMER KIT					
TLE1360A	POWER AMPLIFIER					
THN6121A	CABINET					
TLN4433A	CABINET ACCESSORY KIT					
TLN8036A	BLANK CHASSIS					
TLN4498AV	JUNCTION BOX					
TLN4499A	BLOWER KIT					
TLN4500A	METER PANEL					
TKN6498A	CABLE KIT					
TLN1190A	CHANNEL ELEMENT (TRANSMITTER)					
CER106B	CHANNEL ELEMENT (RECEIVER)					
TLN6824A	"VIBRASENDER" RESONANT REED					
TLN8381A	"VIBRASPONDER" RESONANT REED					
TLN8805A	TUNING TOOL KIT					
TLN8799A	CIRCUIT BOARD SERVICING KIT					
TLN1386A	FILTER & PANEL					
TKN6496A	COAXIAL CABLE KIT					

EPS-5333-O



## GUARANTEED PERFORMANCE SPECIFICATIONS

### GENERAL

AC INPUT REQUIREMENTS	Receive: 6 amps Transmit: 12 amps @ 120 V ac 50/60 Hz
FREQUENCY RANGE	450-470 MHz
CABINET DIMENSIONS	21-3/4" wide x 82" high x 20-1/4" deep
WEIGHT	550 lbs.

### TRANSMITTER

RF POWER OUTPUT	250/275 watts
OUTPUT IMPEDANCE	50 ohms
SPURIOUS & HARMONIC EMISSIONS	More than 85 dB below carrier
FREQUENCY STABILITY	Temperature-compensated channel element maintains carrier within $\pm .0002\%$ of assigned center frequency from $-30^{\circ}\text{C}$ to $+60^{\circ}\text{C}$ ( $+25^{\circ}\text{C}$ reference).
MODULATION	16F3: $\pm 5$ kHz for 100% at 1000 Hz
AUDIO SENSITIVITY	.165 volt $\pm 3$ dB at microphone terminal or -20 dB at the control line terminal for 2/3 maximum deviation at 1000 Hz
FM NOISE	-55 dB below 2/3 system deviation at 1000 Hz
AUDIO RESPONSE	+1, -3 dB of 6 dB/octave pre-emphasis characteristic from 300-3000 Hz referenced to 1000 Hz
AUDIO DISTORTION	Less than 3% at 1000 Hz for 2/3 system deviation. 300 to 3000 Hz.

### RECEIVER

CHANNEL SPACING	25 kHz
SELECTIVITY EIA SINAD	-90 dB
EIA SINAD INTERMODULATION	-80 dB; -75 dB with optional preamplifier
EIA MODULATION ACCEPTANCE	$\pm 7$ kHz minimum
SENSITIVITY	Less than .5 microvolt for 20 dB quieting; less than .35 microvolt for EIA SINAD; less than .25 microvolt for 20 dB quieting; less than .175 microvolt for EIA SINAD with optional preamplifier.
FREQUENCY STABILITY	Temperature-compensated AFC channel element maintains oscillator frequency within $\pm .0002\%$ of reference frequency from $-30^{\circ}\text{C}$ to $+60^{\circ}\text{C}$ ambient ( $+25^{\circ}\text{C}$ reference).
SPURIOUS & IMAGE REJECTION	More than 100 dB More than 90 dB with optional preamplifier
SQUELCH	Carrier Squelch: Noise compensated type, adjustable sensitivity, threshold sensitivity of 0.25 microvolt or less (Patent No. 2343115 other patents pending). "Private-Line" Tone-Coded Squelch: Also includes a tone-operated squelch circuit with a fixed sensitivity of 0.25 microvolt or less (Patent No. 2688059). With preamplifier, both types have sensitivity of 0.15 microvolt or less.
AUDIO OUTPUT	Line output: +18 dBm at 600 ohms; less than 3% distortion. Speaker: 5 watts at 3.2 ohms; less than 5% distortion at 1000 Hz.
AUDIO RESPONSE	Line output: +1, -3 dB of 6 dB/octave de-emphasis characteristic from 300-3000 Hz; Hum & Noise: -50 dB Speaker: +1, -3 dB of 6 dB/octave de-emphasis characteristic from 300-3000 Hz

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

FCC LICENSE DESIGNATION: CC4101CF 250 Watt Output  
CC4101C 275 Watt Output

EPS-4014-A



# FOREWORD

## SCOPE OF INSTRUCTION MANUAL

This manual offers descriptive and service information for the radios described in it. Service diagrams, parts lists, and printed circuit board details are also included.

## NOMENCLATURE

Motorola radio equipment is specifically identified by the model number on the nameplate.

### NOTE

Be sure to use the entire model number when making inquiries about your equipment.

Identifiers have been assigned to chassis and kits. Use these identifiers when requesting information or ordering replacements.

## PRODUCTION CHANGES

When production and engineering changes are incorporated into the equipment, a revision numeral is assigned to the chassis or kit affected.

### Typical Example:

The Model TRD1432AA becomes  
TRD1432AA-1 with the first revision.

This chassis number complete with revision numeral, if any, is stamped on the chassis at the time of production. The revision numeral becomes an integral part of the chassis identifier.

## INSTRUCTION MANUAL REVISIONS

Changes which occur after an instruction manual is printed are described in the Instruction Manual Revision. These bulletins give the reader complete information on the change including pertinent parts listing data.

## NATIONAL SERVICE ORGANIZATION

Motorola provides a nation-wide service organization. Through its maintenance and installation program Motorola makes available the finest service to those desiring reliable continuous communications on a contract basis.



The largest service organization specializing in mobile communications is Motorola's National Service Organization. Over 800 strategically located, adequately staffed and trained, independently owned and operated stations, manned with several thousand FCC licensed personnel constitute the sub-contracting force.

The administrative forces of area and district service managers and district service representatives are in the direct employ of Motorola.

For your contract service requirements, please contact your local Motorola representative or write to:

National Service Manager  
Motorola Communications Division  
1301 E. Algonquin Road, Schaumburg, Ill. 60172

CAREFUL USE OF THE INSTRUCTION MANUAL AND THE MANY SUGGESTIONS CONTAINED IN IT WILL FURTHER INSURE PROPERLY INSTALLED AND MAINTAINED RADIO EQUIPMENT.

THE EQUIPMENT DESCRIBED IN THIS MANUAL IS MANUFACTURED UNDER  
ONE OR MORE OF THE FOLLOWING MOTOROLA U.S. PATENTS:

RE-24, 815	2, 834, 879	3, 059, 184	3, 204, 202	3, 306, 990	3, 387, 270
RE-26, 079	2, 883, 521	3, 061, 785	3, 205, 455	3, 307, 051	3, 400, 219
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2, 650, 333	2, 912, 573	3, 087, 117	3, 234, 469	3, 327, 215	3, 424, 854
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2, 777, 950	3, 027, 454	3, 175, 183	3, 293, 644	3, 348, 148	3, 458, 664
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2, 808, 507	3, 039, 081	3, 175, 193	3, 304, 501	3, 355, 709	3, 469, 191
2, 809, 236	3, 041, 550	3, 183, 382	3, 304, 503	3, 369, 597	3, 471, 796
2, 830, 200	3, 048, 659	3, 191, 123	3, 305, 779	3, 370, 236	3, 471, 805
2, 833, 994	3, 048, 747			3, 373, 379	3, 473, 152

Other U.S. Patents Pending



# REPLACEMENT PARTS ORDERING

## ORDERING INFORMATION

Motorola maintains parts and service depots and authorized service stations strategically located throughout the country. These facilities are fully equipped to give the finest service. Orders for all parts except crystals, channel elements, and "Vibrasender" and "Vibrasponder" resonant reeds should be sent to the nearest parts and service depot. Orders for crystals, channel elements and reeds should be sent to the factory address listed below.

When ordering replacement parts, the complete number identification of the item must be used whether it be a component, kit or complete chassis. This will fix proper identification and assure delivery of the desired item. Complete number identification should also be used when requesting equipment information.

Crystal and channel element orders should specify the crystal or channel element type number, crystal frequency, carrier frequency, and the chassis model number in which the part is used.

Orders for "Vibrasender" and "Vibrasponder" resonant reeds should specify type number and frequency and should identify the owner/operator of the communications systems in which these items are to be used.

## PARTS AND SERVICE LOCATIONS

Motorola, Inc.

Parts and Service Depot

2333 Utah Ave. El Segundo, California 90245

1170 Chess Drive, San Mateo, California 94404

Lake Mirror Road, Forest Park, Georgia 30050

1875 Greenleaf Ave., Elk Grove Village, Ill.  
60007

85 Harriston Road, Glen Rock, New Jersey 07452

12955 Snow Rd., Parma, Ohio 44130

3220 Belt Line Road, Dallas, Texas 75234

## FACTORY ADDRESS FOR CRYSTAL, CHANNEL ELEMENT AND RESONANT REED ORDERS

### AIR MAIL ORDERS

Motorola, Inc.  
Component Service  
Department  
P.O. Box 66191  
O'Hare International Airport  
Chicago Ill. 60666

### REGULAR MAIL ORDERS AND CORRESPONDENCE

Motorola, Inc.  
Component Service  
Department  
916 North Kilbourn  
Avenue  
Chicago, Illinois  
60651

68P81001E43-C







DESCRIPTION

# STATION PACKAGE

FOR

      TONE REMOTE CONTROL REPEATER STATION

          450-470 MHz                  250/275 W RF POWER

## CONTENTS OF PACKAGE

<u>SECTION</u>	<u>NUMBER</u>
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INSTALLATION AND OPERATION . . . . .	68P81012E23
MISCELLANEOUS	
Metering Kit . . . . .	68P81003E49

## STATION PACKAGE

1. All contents of this package are to be used for the purpose of the project.

2. The contents of this package are to be used for the purpose of the project.

## CONTENTS OF PACKAGE

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2. Station Package  
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1. Station Package  
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4. Station Package



## 1. INTRODUCTION

This manual describes two Motorola transistorized upright repeater (RT) stations designed for remote audio tone wire line control operation. These FM two-way radio stations contain control circuitry for automatic retransmission of all received messages. The model complement of these two continuous duty stations is shown in the model chart at the front of this manual.

The stations employ completely transistorized receivers, exciters, power supplies, and control units. Only the driver amplifier and high voltage amplifier stages of the transmitter use tubes. The advantages of the transistor -- low current requirements, reliability; light weight, compact size and low maintenance requirements -- are fully utilized. Solid-state switching is used except for the antenna relay and interlock relays. Current requirements are lowered by the use of unheated, temperature-compensated, plug-in oscillator modules (channel elements) for frequency control. A blower is provided to cool the high voltage amplifier tubes.

The base station is constructed so all tuning and metering controls are accessible without interrupting communications. There is no interlock on the front door since there are no high voltages present on the front panels. Local control facilities are provided for servicing purposes. The base station cabinets are designed with a basic frame construction covered by a sheet metal outer covering. The top, sides, and doors are easily removed and replaced.

### NOTE

Before the station is ready to transmit, it is necessary to turn on the main

power switch and the high voltage switch located on the high voltage power supply and the high voltage switch located on the driver amplifier.

## 2. "PRIVATE-LINE" TONE-CODED SQUELCH OR CARRIER SQUELCH

### a. "Private-Line" Tone-Coded Squelch

The use of "Private-Line" tone-coded squelch stations improves radio communications especially when operating under crowded channel conditions. Several "Private-Line" (PL) networks can use the same rf carrier frequency in the same area. Receivers will accept only the messages transmitted by units in the same net. The speaker will remain quiet during all other transmissions; personnel will not have to listen to transmissions originating outside their PL network.

"Private-Line" transmitters are modulated by a continuous sub-audible tone in addition to the voice modulation. The receivers accept only signals which are modulated with the correct tone and reject all others unless the PL squelch circuit is disabled. At that time, the noise operated squelch circuit is placed in operation and all on-frequency signals are heard. When the PL squelch circuit is activated, the noise squelch circuit is disabled.

### b. Carrier Squelch

In carrier squelch stations all transmissions on a specific frequency are received. The receiver incorporates a noise squelch circuit that eliminates disturbing noise when no transmissions are being received.



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**Communications Division**

SCHAUMBURG, ILLINOIS 60172

### 3. APPLICATION

Motorola repeater (RT) stations are for use in two-way FM radio communications systems where extended range operation is required or where natural or man-made limitations to direct communications are encountered. The station is used primarily for "mobile relay" or "one-way talk-back" repeater applications. Refer to the accompanying diagram for typical examples of these unique repeater circuits.

In a "mobile relay" circuit signals as received by the repeater receiver from one mobile unit are rebroadcast to other mobiles by the repeater transmitter. Mobiles operating in a system of this type must employ a transmitter and receiver of different frequencies. The repeater transmitter and receiver will consequently be aligned on exactly the reverse frequencies of the transmitters and receivers of the mobile units.

In a "one-way talk-back" repeater circuit, signals as broadcast by a mobile unit in the vicinity of the repeater installation are picked up by the repeater receiver and retransmitted by the repeater transmitter to a distant base station in the system. Return signals as transmitted by the base station are received directly by the mobile receiver. The mobile transmitter and receiver are normally aligned on the same frequency in this type of system. The associated repeater receiver is aligned to the mobile transmitter frequency while the repeater transmitter is aligned to the unique frequency of the remote base station receiver.

With optional modules, this station has the capability of functioning both with an rf input (RT) and wire line control. When the remote supervisory facilities are not used in the operation of this station, the station functions automatically; i. e., all control functions for the station are initiated via the rf carrier. As a signal is received by the receiver the transmitter is automatically actuated. The output of the receiver is fed to the transmitter modulator input circuit so that the received signal is rebroadcast at greatly increased power on the repeater transmitter frequency.

A station using supervisory remote wire line control will operate as a repeater (RT) station when an rf carrier is received, provided the remote console operator is not keying the station. The remote console operator may monitor messages received by the repeater or originate messages from the console. The console operator has priority over the repeater station.

### 4. CONTROL FACILITIES

These stations contain a transistorized remote control unit which is used to provide the specific switching functions required for operation of the station. Control of the station's functions from a remote point is accomplished by applying various audio frequency tones to optional modules in the remote control unit via the control line from the remote control console.

A Motorola Tone Remote Control Console, Model T1367AM (or equivalent) is required at the control location for these stations. It must provide:

- a. Microphone audio and accept receiver audio from a 600-ohm line.
- b. 2175 Hz guard tone to prepare the station for accepting function tones.
- c. 1950 Hz tone for transmitter keying.
- d. 2050 Hz tone for PL disabling function. (PL models only.)

### 5. DESCRIPTION OF ITEMS

#### a. Receiver

The completely transistorized receivers in these stations are crystal-controlled dual conversion models. Audio output for local speaker operation and +14 dBm of audio to the control line are provided with separate adjustments.

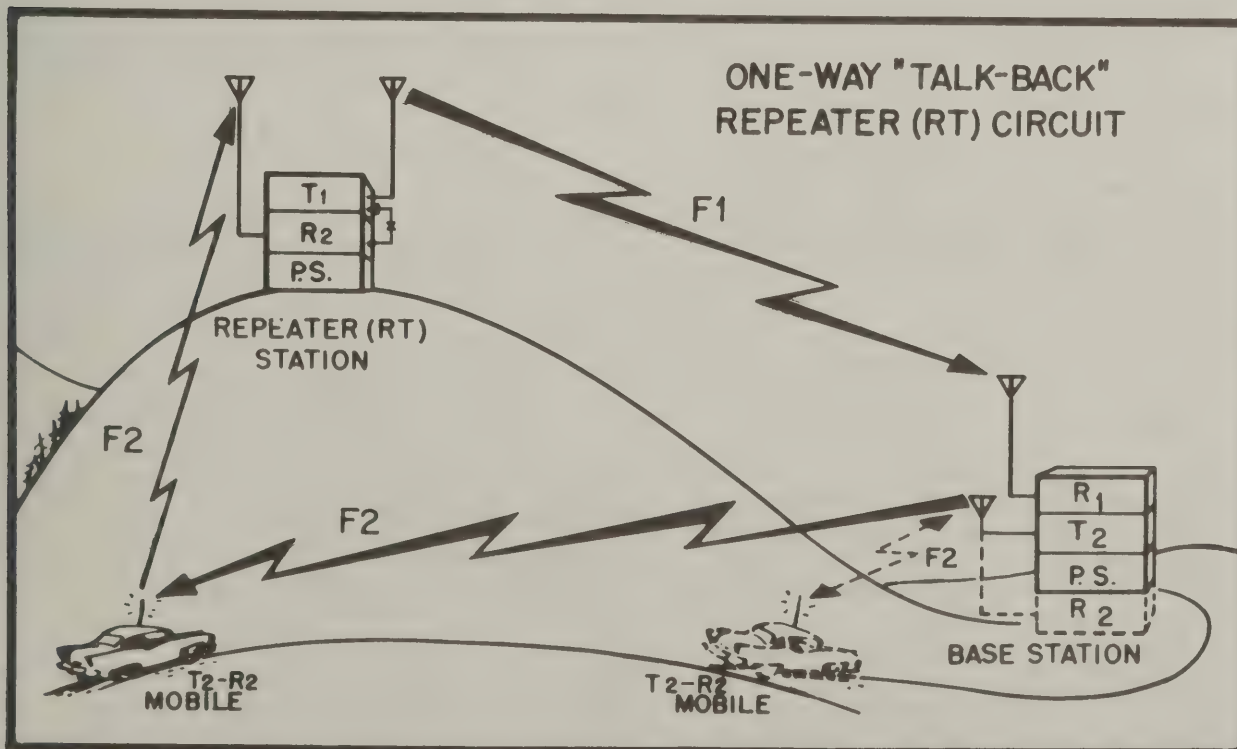
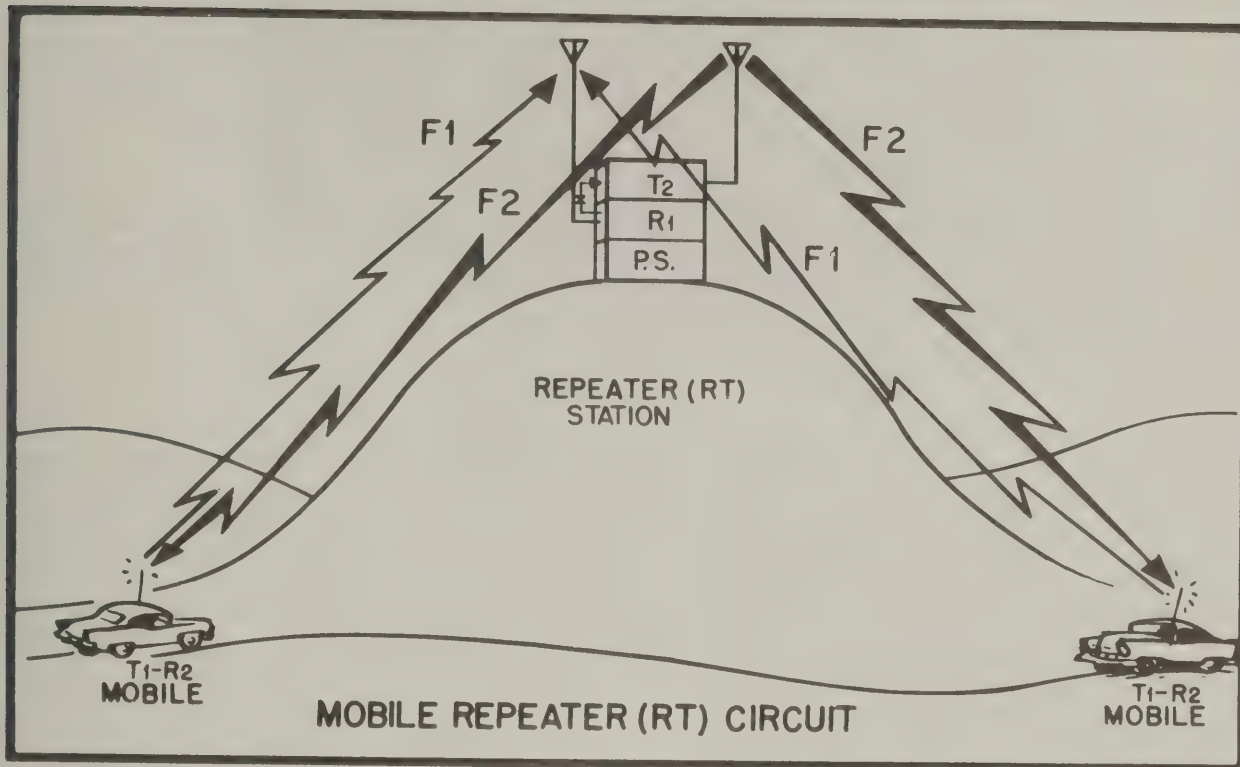
The rf preselector and a sealed, life-time guaranteed "Permakay"® filter in the i-f stages determine the excellent bandwidth and selectivity characteristics of the receiver. Temperature-compensated, plug-in crystal oscillator modules (channel elements) provide excellent frequency stability without the use of crystal ovens. Disturbing noise during periods when no messages are being received is eliminated by noise actuated squelch circuitry.

#### b. Transmitter

Circuits include an unheated, temperature-compensated crystal oscillator module (channel element). The channel elements used in these stations are high stability channel elements which provide  $\pm 0.0002\%$  frequency stability. Also included are; transistorized audio amplifier and IDC ("Instantaneous Deviation Control") circuit, varactor phase modulator, completely transistorized



# TYPICAL REPEATER SYSTEMS USING A MOTOROLA REPEATER (RT) STATION



69C836116-B

Typical Repeater (RT) Station Applications

DESCRIPTION

exciter (frequency multipliers and amplifiers), and tube-type driver and power amplifier stages. A high level of harmonic frequency attenuation is achieved in a harmonic filter at the transmitter output.

c. Power Supplies

The power supplies provide all voltages necessary for the operation of the station. These units use solid-state circuits for all voltage and function switching with the exception of the two relays in the relay door interlock circuit.

d. Meter Panels

This panel includes meters that can be used to indicate the power amplifier plate voltage, upper and lower tube plate currents, and the grid current. Two indicator lamps are provided on the meter panel. The amber lamp indicates when power is applied to the station, and the red lamp indicates when the transmitter is keyed.

e. Power and Audio Line Junction Box

The junction box is provided as a convenient means of connecting the 120-volt ac line and the control lines used for remote operation of the station. Two ac receptacles and the main station fuse are also located on this box.

f. Remote Control Unit

The remote control unit consisting of a remote control chassis and solid-state, plug-in modules permits the station to be operated as a repeater (RT) and performs various control or operational functions for the station. Optional modules permit remote operation in addition to repeater (RT) operation. The basic repeater (RT) station includes the following plug-in modules:

(1) Station Logic

This module controls transmitter keying, receiver muting, and the local microphone ground output in response to the squelch gate module push-to-talk, R1 mute inhibit and transmitter key inhibit outputs.

(2) Squelch Gate

The squelch gate module produces an output that activates the transmitter when a carrier signal is received that has a sufficiently high signal-to-noise ratio and a proper PL tone.

(3) Time-Out Timer

This completely transistorized timer is used to turn off the transmitter after a predetermined transmission time for each message. It is adjustable in steps from 1/2 to 8 minutes.

(4) Local Control

This module provides local control and metering facilities for service and maintenance. It also contains the PL tone encoder circuits for the station.

(5) Line Driver

This module is required for remote control operation. It amplifies the receiver audio which is routed to the remote control point over wire lines, couples audio from the remote control point which is to be transmitted to the "XCTR LEVEL" control in the station logic module and amplifies the audio from the local speaker for intercom application. Thus, it also provides monitoring of all repeater messages.

(6) F1 Control

This module provides a switched ground to the transmitter channel element when it detects a 1950-Hz tone, and provides PL disabling of the receiver when it detects a 2050-Hz tone (in PL stations only).

(7) Guard Tone Decoder Module

The guard tone decoder converts a 2175-Hz guard tone signal received from the remote control equipment to a line push-to-talk voltage. The decoder also amplifies and distributes received function tones to other decoders.

(8) Circuit Board Servicing Kit

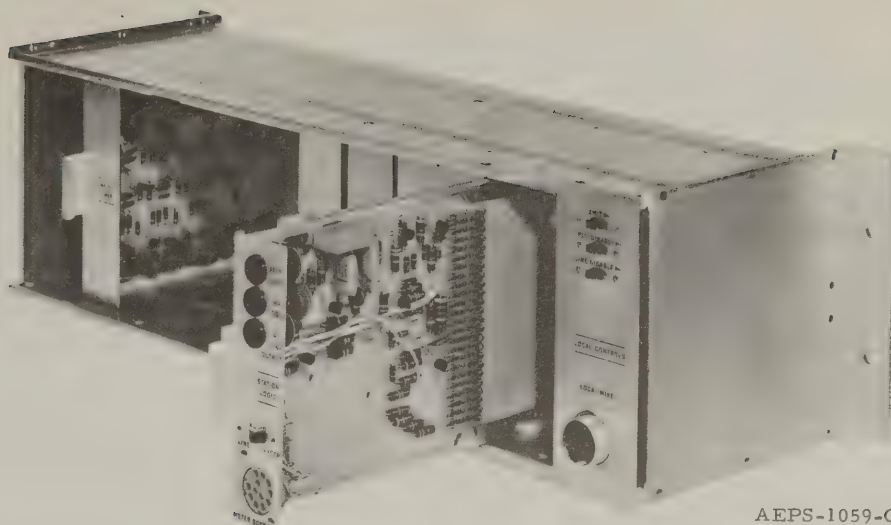
This kit is available for extending the module to provide access for service and maintenance without interrupting the power and signal connections when taking readings.

g. Optional Items

(1) Single-Tone Decoder Module

This module adapts the station for use in single-tone signalling systems. Such a system may use single-tone frequencies to select a specific function instead of using a current level. Other typical applications for the module are remote monitoring and control of external signalling devices.





Module Extended for Service and Maintenance

(2) "Wild Card" Control Module

This module provides for tone-activated control circuits to perform distantly located functions. Each individual circuit, when activated, provides a ground for a 100-milliampere circuit to operate the specific function.

(3) Squelch Control Module

This module operates with 1450 or 1550 Hz function tones to provide two levels of squelch sensitivity.

(4) Relay Kit

These relays are for use in conjunction with the "Wild Card" control, single-tone decoder and squelch gate modules. They provide a form "C" output circuit, which is isolated from the module board circuitry, with higher voltage and current switching capability than that provided by the normal transistor output.

(5) Repeater Control Module

A 1450-Hz tone command from a remote control point activates circuitry on this module to "set up" repeater operation. A 1550 Hz tone command disables repeater operation.

(6) Metering Kit

The metering kit permits metering of the receiver, exciter amplifier, and driver amplifier. In addition, the unit provides intercom between the station and the remote control point when adjusting or testing the station.

(7) Transmitter Shield Kit

The transmitter shield kit provides additional shielding for the transmitter and helps minimize intermodulation between stations operating in close proximity.

(8) Other Options

Many other options are available for these stations for particular applications. See your local Motorola representative for complete details.

## 6. FUNCTIONAL DESCRIPTION

### a. Repeater Operation

The basic function of a repeater (RT) station is to retransmit received signals. When the receiver detects a certain signal-to-noise ratio, the squelch gate provides information which activates the keying circuits.

The squelch gate has two outputs, one starts the cycle of the time-out timer, the other activates the keying circuit in the remote control unit. The transmitter keying circuit activates the power supply and turns on the transmitter. The received audio is then routed to the exciter modulator for retransmission.

If the squelch gate loses its signal for a period of time longer than the adjusted drop-out time, the input to the transmitter keying circuit is removed, turning off the transmitter. If the squelch gate is on when the timer reaches the end of its cycle, an output from the time-out timer will interrupt operation of the transmitter keying circuit and turn off the transmitter.

## b. Remote Operation

### (1) General

Operation of this equipment as a remotely controlled base station depends upon application to the control line of high level guard tone and function tone (and low level guard tone in transmit) from an external control source such as a Motorola tone remote control console. It should be kept in mind that a remotely controlled station is not able to provide repeater (RT) and remotely controlled base station functions simultaneously. As long as the remote control operator does not interfere with the existing repeater set-up by pressing the microphone push-to-talk button at the remote control site, the equipment provides conventional repeater functions. When the remote operator presses the push-to-talk button, the repeater function is disabled and the station operates as a remotely controlled base station. Releasing the push-to-talk button on the microphone automatically restores repeater operation for associated system stations. The remote control operator always has priority over repeater functions.

### (2) Control Line Connections

The audio and function tones are routed to the line transformer in the remote control chassis of the station. The remote control circuits convert the function tones into signals that are applied to the various modules to enable or inhibit specific functions.

### (3) Transmitter Turn-On

When a 1950 Hz function tone is applied to the control line, the F1 detector circuit output is applied to the F1 bistable. The outputs from the bistable provide a ground to the channel element, thus turning it on.

The high level guard tone activates the remote control circuitry and associated station functions in anticipation of the function tone. The function tone activates the desired mode of operation and completes the cycle except for transmit.

In transmit, after completion of the high level guard tone and function tone, the low level guard tone is applied to the control line as long as the transmit switch is activated. All functions occur simultaneously except the oscillator switched ground which occurs 35 milliseconds after antenna switching.

(a) A ground is applied to the F1 oscillator channel element in the exciter-driver chassis.

(b) The receiver is muted by supplying a ground to the switch in the squelch circuit.

(c) A positive potential is applied to the power amplifier power supply control circuit to permit the B+ and B++ voltages to be applied to the exciter-driver, driver amplifier, and power amplifier.

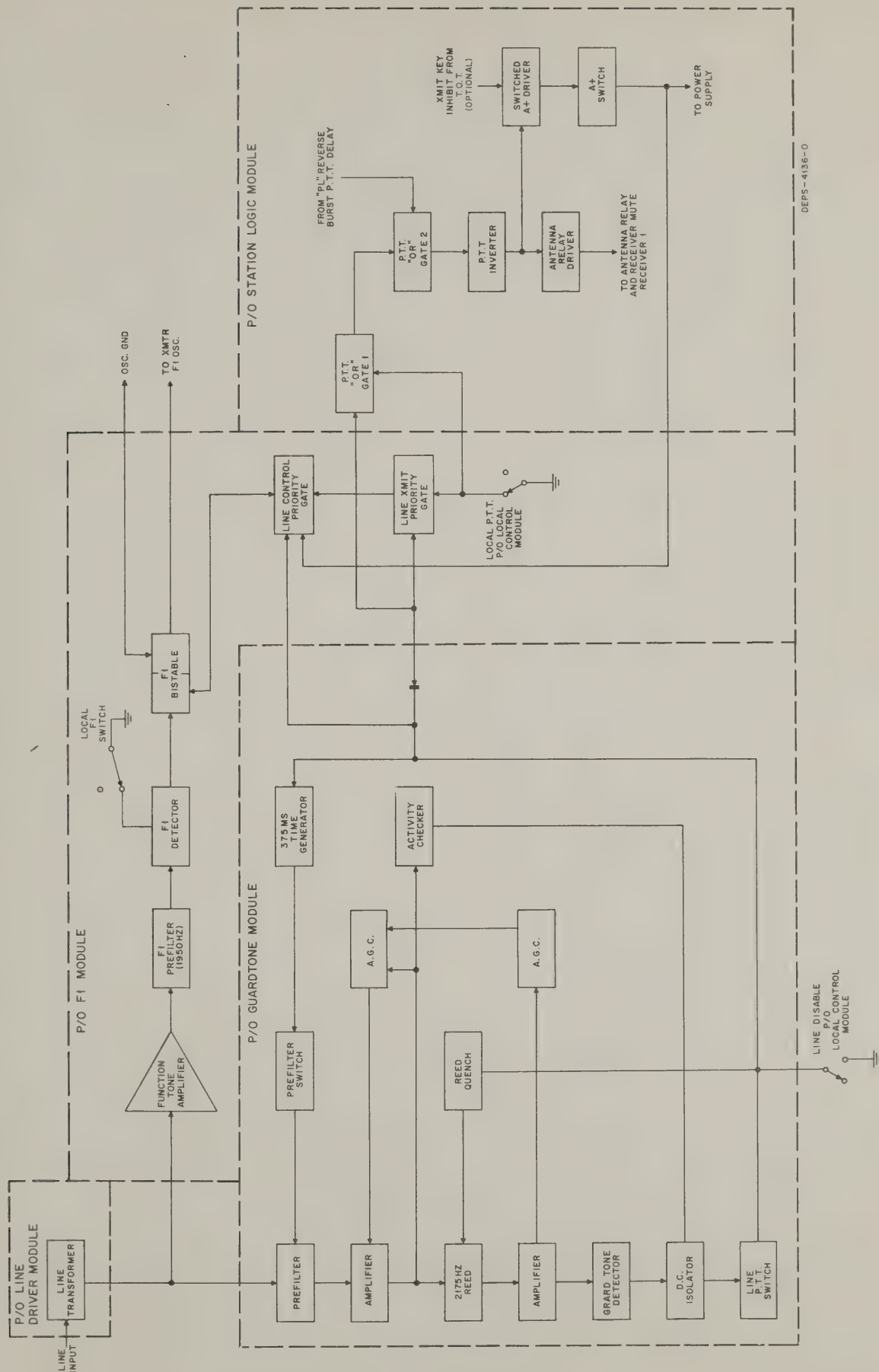
### (4) Transmitter Turn-Off

When low level guard tone is removed from the control lines, all circuits revert to their original state. The power supply (and therefore the transmitter) is held on for 150 milliseconds while a reverse phase "Private-Line" tone is transmitted. This phase shift permits the "Vibrasponder" resonant reed in the listening receiver to be damped rapidly.

### (5) "Private-Line" Disable

When a 2050 Hz "Private-Line" disable tone function is applied to the control line, an output is applied to the receiver, reverting it to noise squelch operation. The receiver will remain in the disable mode until the transmitter is keyed. When the optional PL control module is used, a 1450 Hz tone disables the "Private-Line" squelch for the receiver and it remains in this condition until reset by a 1550 Hz tone.





DEPS-4136-0

Transmitter Turn-On

DESCRIPTION







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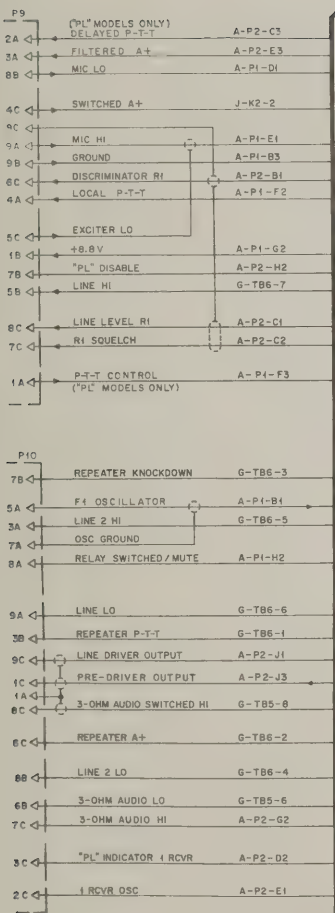












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DIFFERENTIAL  
DRIVERS

AMPLIFIER  
DETECTOR  
OUTPUT  
SWITCH  
NOISE  
SWITCH

OVER  
LOAD  
SENSING

RECTIFIER  
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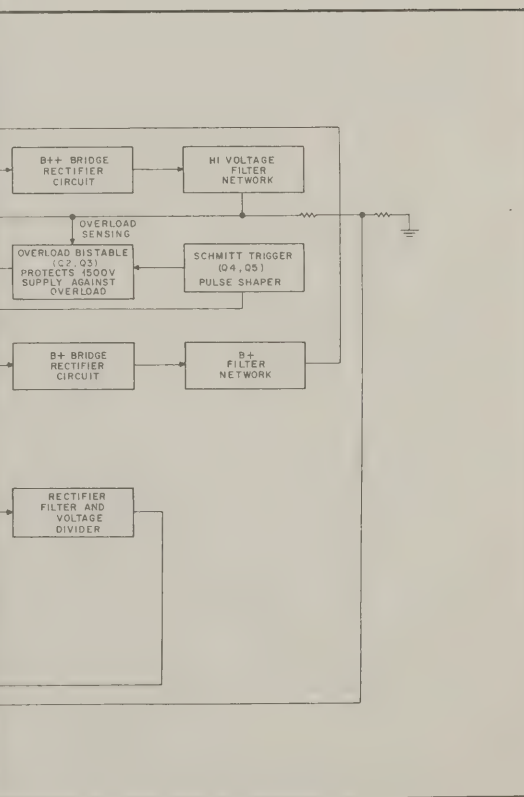
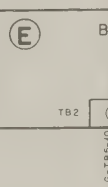
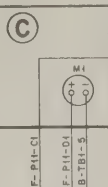
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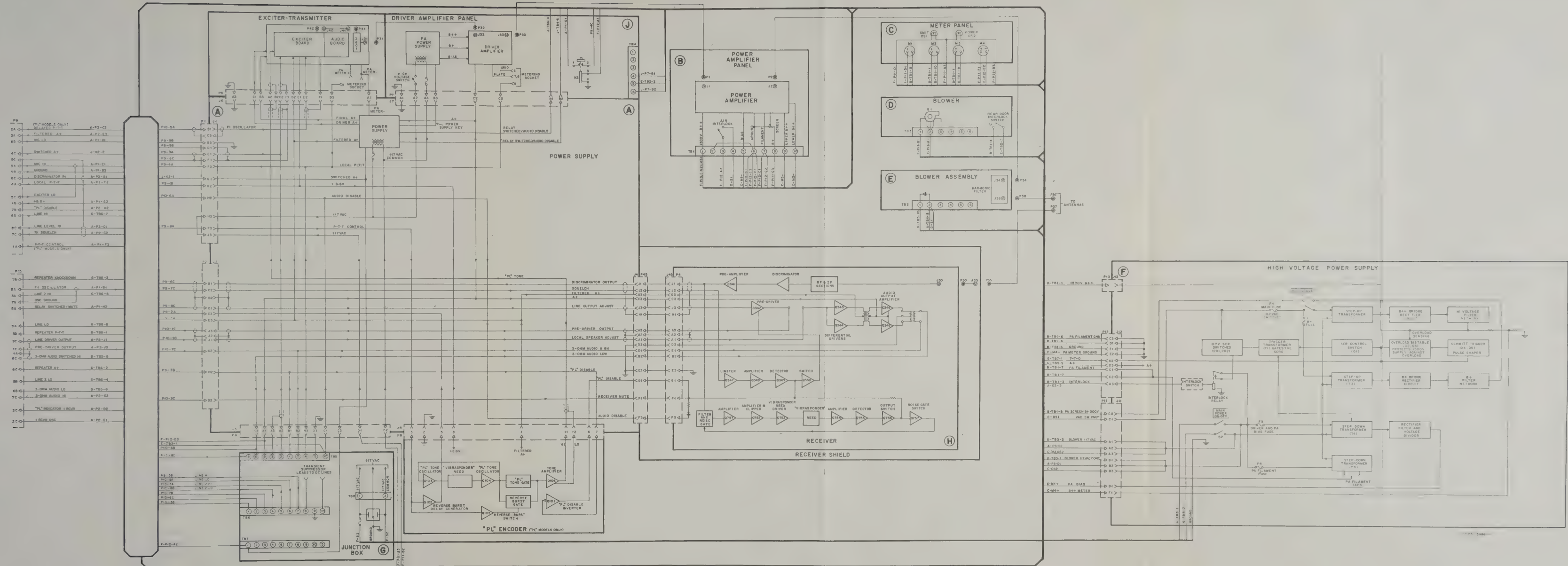


EEPS-3986-O

DESCRIPTION

Detailed Functional Diagram  
 Motorola No. EEPS-3986-O  
 (Sheet 2 of 2)  
 4/28/71-NPC





Detailed Functional Diagram  
 Motorola No. EEPS-3986-O  
 (Sheet 2 of 2)  
 4/28/71-NPC















# INSTALLATION AND OPERATION

## IMPORTANT

FCC regulations state that:

1. Radio transmitters may be tuned or adjusted only by persons holding a 1st or 2nd class commercial radiotelephone operator's license or by personnel working under their immediate supervision.
2. The rf power output of a radio transmitter shall be no more than that required for satisfactory technical operation considering the area to be covered and local conditions.
3. Frequency, deviation and power of a base station transmitter must be checked before it is placed in service and rechecked every year thereafter.

## REMEMBER

The efficiency of the equipment depends upon a good installation.

## 1. UNPACKING

- a. Remove the station from the shipping carton.
- b. Remove the keys taped to the front door; unlock and remove both doors (indoor cabinets). Remove all shipping tape from inside the cabinet.
- c. Remove the center bolt, the two #14 self-tapping screws and speed nuts from the shipping bar assembly across the back of the station. Remove and discard the shipping bar.
- d. Remove the two flat washers from under the side rails and replace the speed nuts.

- e. Replace the two #14 self-tapping screws in the side rails and tighten.

## 2. INSPECTION

Inspect the equipment thoroughly as soon as possible after delivery. If any part of the equipment has been damaged in transit, report the extent of damage to the transportation company immediately.

## 3. INSTALLATION OF CABINET

### a. General

The cabinet should be located on a solid, level surface convenient to the 120 volt ac power source and the transmission line. Allow space for ventilation at the top, front, and rear of the cabinet. The transmission line should be kept as short as possible to minimize line losses.

### b. Ventilation

The cabinets have vents which allow outside air to be drawn in through an opening in the rear door and expelled through an opening in the top. The heated air rising in the cabinet causes a natural draft. Therefore, it is essential that the two openings in the cabinet be kept free of obstructions so the air flow will not be restricted.

A blower is provided to cool the final amplifier tubes. A vent at the top of the rear cabinet door allows outside air to be drawn into the cabinet and is routed to the blower via a flexible vent tube.



**MOTOROLA INC.**

ENGINEERING PUBLICATIONS

1301 E. ALGONQUIN ROAD

**Communications Division**

SCHAUMBURG, ILLINOIS 60172

INSTALLATION AND OPERATION



c. Antenna Cable

**NOTE**

Do not substitute connectors or cables for the ones supplied. The supplied material is for use at the high temperatures which may be encountered in the operation of the equipment when located in a high temperature ambient atmosphere.

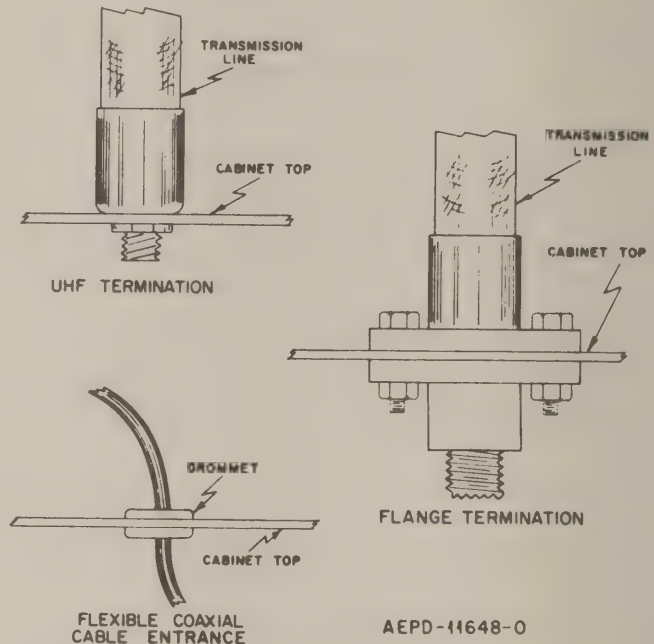
Install the connector as follows:

- (1) Determine the location.
- (2) Use a center punch to mark the location.
- (3) Drill a 1/4-inch pilot hole.
- (4) Use a 3/4-inch hole saw to enlarge the pilot hole.
- (5) Using the connector as a template, mark the location of the three mounting holes.
- (6) Center punch and drill three holes with a 7/32-inch drill.
- (7) Place the gasket (supplied) over the longest stud of the connector.
- (8) Insert the connector from the outside so the gasket is against the outside cabinet wall.
- (9) Secure the connector in place with the three screws, lockwashers and nuts supplied. The nuts should be on the inside of the cabinet.
- (10) Measure and cut the loose ends of the 6-foot coaxial cables attached to the receiver and transmitter so that they will reach the bulkhead fittings (two antenna installations) or the duplexer (one antenna installations). The cable should be made as short as possible to keep power losses to a minimum. Sharp bends in the cable should be avoided to prevent damage to the cable.
- (11) Install the connector(s) and adapter(s) (supplied) to the end of the cable(s) and connect to the proper fitting(s).

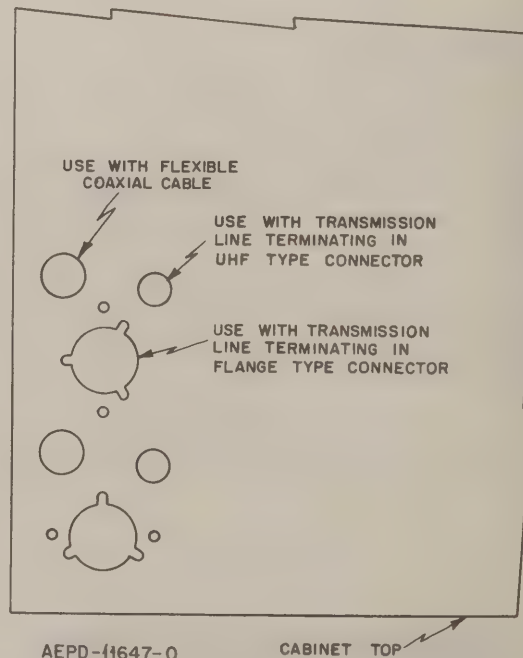
d. Power

For rear cable entry, two punch marks are located on the rear panel of the cabinet base. Using these as centers, drill holes in the cabinet using a 3/4-inch hole saw. When viewed from the rear of the cabinet, the left hand hole is intended for the entrance of ac power and the right hand hole is intended for the entrance of

control lines. The holes are in line with holes in the junction box so that 1/2-inch thinwall or rigid conduit may be installed through the base and directly to the junction box. Install the conduit, or if conduit is not used, install rubber grommets in the holes to protect the cables. Make power connections as described on the inside of the junction box cover. The green wire is an earth ground to reduce shock hazard. It is not connected



Cabinet Antenna Cable Installation



Cabinet Knockout Detail

to the ac supply, but it may be an extra wire in the cable, conduit, or raceway that houses the current carrying wire from the main service entrance. It may also be connected to the conduit or raceway itself as this is connected to earth ground at the main service entrance. All three wires in the conduit should be #12 TW.

For bottom cable entry, power and control cables may be brought in at almost any desired point through the bottom of the cabinet. Refer to the cabinet dimensional detail for specific limitations. Measure and center punch the desired cable entry locations. Using the center punch mark as the center of the holes, drill 3/4-inch holes with a hole saw. Install conduit, or if conduit is not used, install rubber grommets in the holes to protect the cables. Make power connections as described in the previous paragraph.

## 4. CONNECTIONS

### a. Antenna

Installation of the antennas and transmission lines should be made prior to installation of the station. The antennas and transmission lines are not supplied as part of the station equipment; therefore, antenna installation instructions are not included herein. Follow the instructions shipped with the antennas for applicable antenna installation procedures.

In its primary application, the station is used for communication with mobile stations. Antennas exhibiting omni-directional characteristics are desirable. However, if the station is located at the outer perimeter of a communications area or if it is to be used for communications with fixed stations, antennas with specific directional characteristics may be more suitable. FCC requirements may also dictate the type of antenna to be used.

The receiver and transmitter outputs can be located as shown in the intercabling diagram at the end of this section.

### b. Control Line

The station can be controlled from a remote point over wire line circuits. Simplex audio is used, meaning that the remote point can send audio to the station or receive audio from the station, but not both at the same time. Therefore, a single audio pair will suffice. The wire line also carries the audio control tones. These are usually carried by the same pair that carries the

transmit audio, but a separate pair can be used when necessary.

The control line connecting the base station with the remote control unit shall have a nominal 600 ohm impedance, and no more than 30 dB attenuation. Frequency response between 300 Hz and 3 kHz should be as flat as possible within the limitations of line length and economic considerations.

CHARACTERISTICS OF LEASED TELEPHONE LINES SHOULD BE CHECKED WITH THE COMPANY PROVIDING THE SERVICE PER THE ABOVE REQUIREMENTS.

The control line may be installed prior to installation of the cabinet and terminated near the location chosen for the station. Conduit or two-wire cable can be used from this termination to the junction box via the rear or bottom of the cabinet base. Unless otherwise specified, stations are shipped from the factory for standard two-wire operation. Stations factory equipped with a four-wire audio option (two line driver modules) are shipped with all jumpers installed for receiver line audio output on terminals TB6-4 and TB6-5, and transmit audio input with superimposed tone control on TB6-6 and TB6-7. For additional information and alternate line connections, refer to the Audio and Control Line Connection Diagram.

As mentioned previously, the lines used to carry audio have an ac impedance of 600 ohms. The amplitude of signals is most conveniently measured in dBm. Zero dBm is equal to 1 milliwatt across 600 ohms. Most audio voltmeter, such as the Motorola Transistorized AC Voltmeter, are calibrated to read directly in dBm when measuring across a 600-ohm impedance. Never use a voltmeter or a multimeter. Connections internally and externally are as shown on the audio and control line connection diagram.

### c. AC Power

#### (1) Power Requirements

All stations require a 25-ampere, 120-volt 50/60 Hz ac power input. This circuit should be installed in accordance with local electrical codes.

The primary ac power line can be installed and terminated near the station site before installing the station cabinet. If the 3-wire line cord (supplied with the station) is used, the ac power line should be terminated with a 3-contact receptacle to accommodate the plug on the power cord.

## (2) Power Connections

Connect the three-wire ac line cord to the ac outlet or "turn-on" the power to the permanent connection. A power on-off switch is provided in the equipment, therefore with power applied, the equipment is in an inoperative condition until the station on-off switch is placed in the "on" position.

The station fuse controls all power to the station except ac power to the outlet in the junction box.

### **WARNING**

If a three-wire grounded primary ac power source is not available, the radio equipment must be grounded separately to prevent electrical shock hazards and provide lightning protection.

#### d. Optional Driver Amplifier Metering Kit Connections

Connect the speaker 3-ohm audio high (yel) lead to TB9-1 on the metering kit panel terminal strip and the 3-ohm audio low (blk-yel) to TB9-2.

## 5. PRE-OPERATIONAL ADJUSTMENTS

### a. Speech Levels

Most telephone companies limit the maximum signal amplitude which they will allow on their lines. The most common maximum level is +8 vu (volume units), but others allow only 0 vu; check with the telephone company for the maximum level to be used on your lines. Adjust the audio levels to the maximum permissible level which will give the best signal-to-noise ratio.

The vu is the measurement for speech and can be measured only with a vu meter. This meter has special ballistics to control the rise and fall time and the overshoot of speech signal voltages. Since speech signals fluctuate so rapidly, special metering techniques are required. The meter point of a vu meter responds in a series of "kicks" or deflections of varying amplitude. Over a period of time, a majority of peaks will reach approximately the same level. There will be a few very strong peaks which will exceed this level and a few peaks of lower level. These are ignored and the measured speech level equals the majority of the "kicks" or peaks reached. Measurements show that the instantaneous peaks of a speech signal are about 10 dB higher than the vu value (the instantaneous peaks of a 0 vu speech signal will equal the peaks of a sine wave signal of +10 dBm magnitude). Of course, a sine wave signal of +10 dBm would produce a much greater volume because every cycle of the signal goes to peak amplitude.

Adjustment of the audio line levels is very difficult using actual speech signals which fluctuate so greatly. A sine wave signal (1000 Hz continuous tone, for example) is much easier to use for adjustments. However, sine wave signals are measured in dBm and the telephone company specifies the maximum signal level in vu. THERE IS NO CONVERSION FROM VU TO DBM OR VICE VERSA when measuring speech. Speech cannot be measured in dBm or converted into dBm. The dBm is a unit to measure the sine wave power as referenced to 1 milliwatt of power. The power of a speech signal of a particular vu is not defined and is different for different speakers. IT IS POSSIBLE TO CALIBRATE A VU METER BY USING A SINE WAVE SIGNAL ON THE 600-OHM LINE, THEN MEASURING THE SAME SIGNAL IN DBM WITH A VOLTMETER. On a 600-ohm line, a sine wave signal that will produce a 0 vu reading will measure 0 dBm on a voltmeter. This does not mean that 0 vu is equal to 0 dBm. Remember, the peaks of an actual 0 vu speech signal will have instantaneous peaks of +10 dBm amplitude.

We would normally conclude that sine wave signal levels would be adjusted 10 dB higher than the vu level specified for the line. EXPERIMENTAL MEASUREMENTS HAVE PROVEN THAT SINE WAVE SIGNAL LINE LEVELS SHOULD BE 6 DB HIGHER THAN THE VU LEVEL SPECIFIED FOR THE LINE (+8 vu speech level should be adjusted for +14 dBm tone level; 0 vu speech level should be adjusted for +6 dBm tone level).

600-OHM LINE VU, DBM, AND  
VOLTAGE EQUIVALENCY CHART

If Maximum Speech Level For Line Is	Adjust Tone Line Level for (1 mW ref.)	Voltage Equivalent
+14 vu	+20 dBm	7.74 V
+12 vu	+18 dBm	6.15 V
+10 vu	+16 dBm	4.88 V
+ 8 vu	+14 dBm	3.88 V
+ 6 vu	+12 dBm	3.08 V
+ 4 vu	+10 dBm	2.44 V
+ 2 vu	+ 8 dBm	1.94 V
0 vu	+ 6 dBm	1.54 V
- 2 vu	+ 4 dBm	1.22 V
- 4 vu	+ 2 dBm	0.97 V
- 6 vu	0 dBm	0.77 V
- 8 vu	- 2 dBm	0.61 V
-10 vu	- 4 dBm	0.48 V
-12 vu	- 6 dBm	0.38 V
-14 vu	- 8 dBm	0.30 V
-16 vu	-10 dBm	0.24 V
-18 vu	-12 dBm	0.19 V
-20 vu	-14 dBm	0.15 V
-22 vu	-16 dBm	0.12 V
-24 vu	-18 dBm	0.09 V
-26 vu	-20 dBm	0.07 V



b. Control Tone Levels

The control tone levels for the remotely controlled functions are adjusted at the remote control console. No additional adjustment is required. The Tone Function Table lists the control tone frequency and function.

tone FUNCTION TABLE

tone FREQUENCY	FUNCTION
2175 Hz	GUARD TONE
2050 Hz	"PL" DISABLE
1950 Hz	F1 SELECTION
1550 Hz	OPERATE "PL" OR OPERATE TIGHT SQUELCH OR RPTR KNOCK-DOWN
1450 Hz	OPERATE CARRIER SQUELCH OR OPERATE THRESHOLD SQUELCH OR RPTR SET-UP
1350 Hz	"WILD CARD" CONTROL
1250 Hz	"WILD CARD" CONTROL
1150 Hz	"WILD CARD" CONTROL
1050 Hz	"WILD CARD" CONTROL

c. Audio Level Settings

Determine the maximum allowable audio level permitted on the lines (use +8 vu for non-regulated lines) and set line audio levels to this amplitude. Refer to the 600-OHM, VU, DBM AND VOLTAGE EQUIVALENCY CHART for tone levels to be used.

**NOTE**

The following procedures assume the most common +8 vu speech level (+14 dBm tone level). For other speech levels, use a tone level 6 dB higher than the vu level (for 0 vu use +6 dBm); refer to the equivalency chart. On some lines, tone levels are not permitted to exceed the speech levels, even for short test tones (for example, maximum speech level of 0 vu and maximum tone level of 0 dBm). When such regulations apply, use the special procedures for low level test tone which follows in subparagraph (4).

(1) Transmit Audio Level

(a) Apply a 1000 Hz audio tone at the remote control console which will drive the amplifier into compression. Adjust the output of the remote control console for +14 dBm (or other equivalent) on the transmit audio line as it leaves the remote control console.

(b) Connect an audio voltmeter to pins 1 and 2 of the local microphone receptacle, or TB1-2 and 3.

(c) Adjust the XCTR LEVEL control for the voltage reading stamped on the exciter with +14 dBm (or other equivalent) applied at the remote control console. This setting is 3 dB above the modulator sensitivity of the transmitter and will permit voice peaks to drive the deviation limiting circuit about 6 dB into limiting. This setting gives the best compromise of intelligibility, range, and clarity.

(d) An alternate method for setting the transmitter audio level is to connect a Motorola portable test set with adapter cable to the metering receptacle on the remote control unit. Set the function switch on the test set to the XMTR position and the selector switch to position 11 (AUDIO). Key the transmitter at the remote control console and set the AUDIO switch on the station logic module to the XCTR position. Hold the multiplier switch of the test set in the 0.2 volt position and adjust the XCTR LEVEL control on the station logic module so the test set reading equals the value stamped on the exciter.

(2) Receive Audio Level

(a) Inject a 1000 uV carrier frequency signal at the antenna of the receiver. Modulate the signal with a 1000 Hz tone at full rated deviation ( $\pm 5$  kHz) or have a transmitter in the network send this type of test signal.

(b) Connect an audio voltmeter across the receive audio line at the station.

(c) Adjust the line level control (R#1 LINE OUTPUT) on the station logic module for +14 dBm (or other vu level equivalent).

(d) The audio level may also be measured on a Motorola portable test set connected to the metering receptacle of the remote control unit with an adapter cable. With the function switch in the XMTR position and the selector switch in position 11 (AUDIO), and the AUDIO switch on the station logic module in the LINE position, the test set meter should read 0.39 volt, for lines that are set to +14 dBm.

(e) If the station is not equipped with a local speaker, connect a 3-ohm speaker or load across TB5-6 and 7 in the junction box.

(f) Adjust LOCAL SPEAKER LEVEL for 3 volts across TB5-6 and 7, or if the intercom feature is used, across TB5-6 and 8. This equipment and set up will be used in the following level adjustments also.

### (3) Squelch Gate and Repeater Audio Level

(a) Inject a 1000 uV carrier frequency signal at the antenna receptacle of the receiver. Modulate the signal with a 1000 Hz tone at full rated deviation ( $\pm 5$  kHz) or have a transmitter in the network send this type of test signal.

(b) Connect an audio voltmeter to pins 1 and 2 of the local microphone receptacle or TB5-2 and 3.

(c) Adjust the REPEATER SQUELCH KEY control on the squelch gate module for the operating threshold point that causes transmitter keying at 20 dB quieting.

(d) Adjust the REPEATER LEVEL control on the squelch gate module for the voltage reading stamped on the exciter.

The station is now ready for operation.

### (4) Special Procedure for Low Level Test Tone

#### NOTE

The following procedure is written for the most common 0 vu speech level and 0 dBm test tone level, but other levels may be used by substituting appropriate levels (levels across the 600-ohm load 6 dB higher than the specified line level).

(a) Terminate the remote control console in a 600-ohm load resistor rather than the line.

(b) Apply a 1000 Hz audio tone at the remote control console which will drive the amplifier into compression.

(c) Connect an audio voltmeter across the 600-ohm load and adjust the line output for +6 dBm.

(d) Reduce the audio input until the meter reads 0 dBm.

(e) Reduce the 600-ohm load and reconnect the line. Readjust the line output for 0 dBm across the line. Do not change the tone oscillator level.

(f) Connect the audio voltmeter to pins 1 and 2 of the local microphone at the station and adjust the XCTR LEVEL control for 6 dB less than the value stamped on the exciter.

(g) Disconnect the line at the station and connect a 600-ohm load in its place.

(h) Apply a 1000 uV carrier signal to the receiver antenna terminal from an FM signal generator. Modulate the carrier signal with a 1000 Hz tone at  $\pm 5$  kHz deviation.

(i) Connect an audio voltmeter across the 600-ohm load and adjust the R#1 LINE OUTPUT control for +6 dBm.

(j) Reduce the deviation until the voltmeter reads 0 dBm.

(k) Remove the 600-ohm load and reconnect the line. Readjust the deviation for 0 dBm as measured across the line.

### d. Intercom (Optional Feature)

Audio communications (intercom) between the station and the remote control point are required during adjustment and testing of the station. The remote control unit includes an intercom amplifier circuit but a local speaker is also required. A Motorola Model TLN8204A Metering Kit can be used for the local speaker. Any 3-ohm, 5 watt speaker may be connected to TB5-6 and 8 of the junction box and used for intercom during adjustment and testing of the station and removed when testing is completed.

Line audio from the remote point is heard on the local speaker, and the speaker is used as an intercom microphone when the INTERCOM switch on the line driver module is held in the TALK position.

A jumper on the line driver module (the AMP LEV lead) selects the line level for the audio that is carried from the station to the remote control point. When the line is installed, intercommunications should be established and the jumper connected to the pin which will provide an audio level that most closely approximates the audio level for receive operation. Connect the AMP LEV lead to the +18, 0, or -8 pin and test for satisfactory operation.

### e. Time-Out Timer Module

This station is equipped with a time-out timer module and a dropout delay generator (located in the squelch gate module) that prevents

unintentional continuous transmission. The timing jumper on the time-out timer module (connected at the time of installation) can be set for 1/2, 1, 2, 4, or 8 minute operation while the dropout delay generator can be set for 0, 1, 2, 4, or 8 second operation.

The dropout delay generator prevents the transmitter from shutting off during loss or excessive fade of input signal for the length of time preset.

The time-out timer will reset to its preset timed interval each time a new input signal arrives at the radio whether or not the dropout delay generator has shut the transmitter off.

## NOTE

A station status chart is located at the back of this manual to record the status of all jumpers at the time of installation. Keep the chart up-to-date as changes occur or modules are added to simplify servicing, modification or replacement of modules.

## 6. OPERATING INSTRUCTIONS

### a. Unattended Operation

Once power is applied and the station is properly adjusted, the repeater station operates

## PRE-OPERATIONAL AND ROUTINE CHECK LIST

UNIT	STEP	CHECK
RECEIVER	1	Compare meter readings with the minimum values in the RECEIVER section of this manual. Realign if necessary.
	2	Measure signal level required for 20 dB quieting.
EXCITER-TRANSMITTER	3	Compare meter readings with minimum values in the EXCITER-TRANSMITTER section of this manual. Realign if necessary.
POWER AMPLIFIERS	4	Tune and load.
SYSTEM ADJUSTMENTS	5	Measure power output of transmitter.
	6	Measure transmitter frequency and adjust if necessary.
	7	Measure transmitter voice channel for proper deviation. Adjust IDC if necessary.
	8	Measure exciter modulator sensitivity.
	9	Adjust receiver on-frequency.
	10	Measure and adjust audio input to exciter.
	*11	Check for audio tone inputs.
	*12	Measure and adjust audio output from receivers to line.
	*13	Check proper operation of all remotely controlled functions.
	14	Check repeater operation.
	15	Check all accessory adjustments.
*Required only if remote control feature is utilized.		

## BEFORE LEAVING THE STATION CHECK THE FOLLOWING

1. All external power switches ON.
2. Station operable from remote location.
3. Local speaker OFF (if applicable).
4. Cabinet doors locked.
5. Vents in rear of cabinet unobstructed.



entirely unattended. When the receiver rf input is of sufficient level, the transmitter is keyed and the signal is retransmitted.

#### b. Remote Control

These stations are designed to be controlled from a remote control console over a wire line following the operating instructions for the remote control console.

#### c. Local Control

### WARNING

The transmitter can be keyed by other than local control. Refer to the table shown below.

The station may be operated locally from the remote control unit for maintenance and testing by the following procedure:

(1) If you do not wish the station to be keyed by remote control while you are operating it, set the LINE DISABLE switch in the direction of the arrow. At the conclusion of local operation be sure the line disable switch is returned to the direction opposite the arrow.

(2) Connect a microphone (Motorola Model TMN6013A or equivalent with 4-prong connector) to the microphone receptacle on the local control panel.

(3) Set the LOCAL SPKR switch to the ON position for stations that are equipped with a local speaker, or connect any 3-ohm 5-watt test speaker to TB5-6 and -7 of the junction box. This speaker will be used to monitor all received messages. If

the speaker will be used for an intercom microphone, connect the speaker to TB5-6 and -8.

(4) The station is now ready to receive incoming signals. Upon reception of audio, adjust the LOCAL SPEAKER LEVEL control for the desired volume. This adjustment is located on the line driver module. For non-wire line repeaters, R1 line output controls the speaker volume.

(5) Before transmitting, monitor for any on-frequency transmissions. If the channel is clear, you may transmit.

(6) Transmit by closing the push-to-talk switch and speaking into the microphone.

(7) For intercom operation with the remote control point (such as when coordinating adjustments), audio from the remote point is heard on the local speaker. This audio will not be transmitted if the LINE DISABLE switch is in the direction of the arrow or if the remote control console is in the intercom mode of operation.

(8) To talk on the intercom circuit, hold the INTERCOM switch (located on the line driver module) in the TALK position and speak into the local speaker.

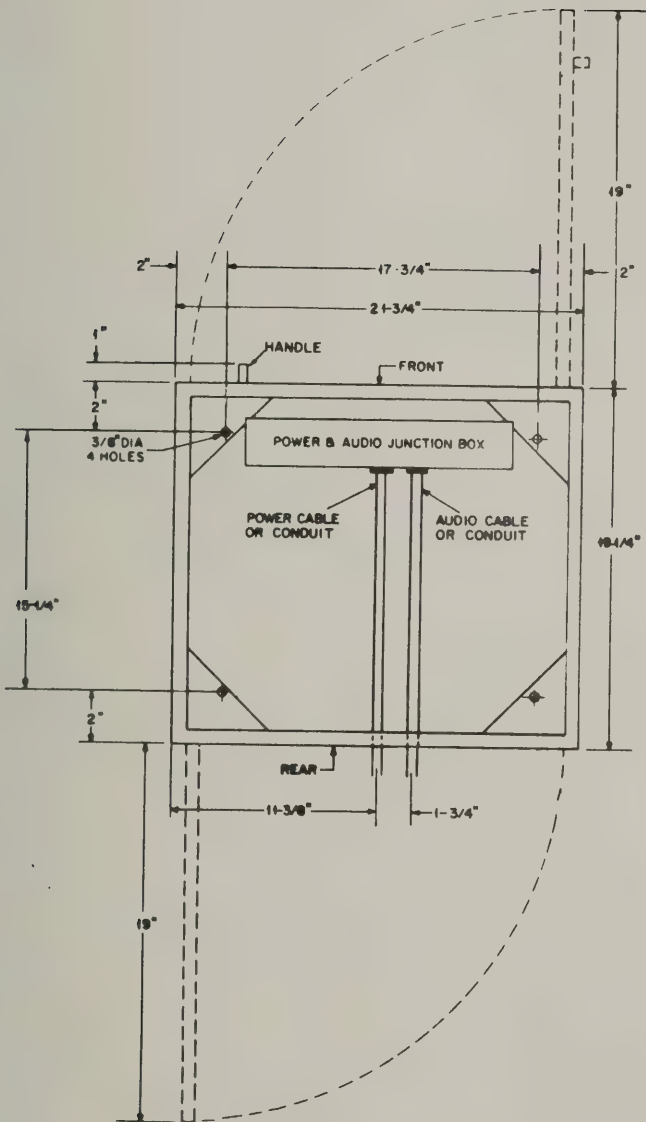
(9) At the conclusion of local operation, be sure the LINE DISABLE switch is returned to the direction opposite the arrow. If the station is equipped with a local speaker, set the LOCAL SPKR switch to OFF. If the station is not equipped with a local speaker, disconnect the test speaker.

LOCAL CONTROL PANEL CONTROLS

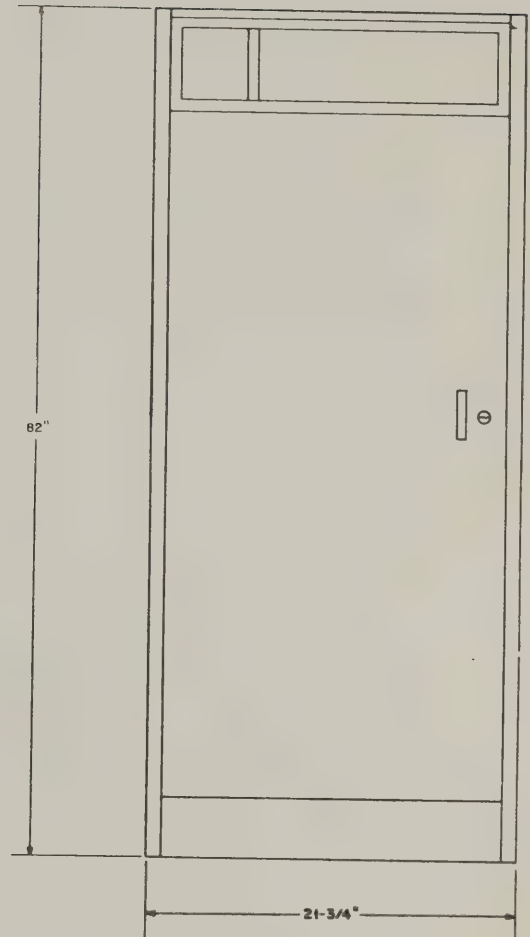
CONTROL	POSITION	FUNCTIONS POSSIBLE
XMIT	Normal (Not Actuated)	Normal mode of operation.
	Actuated (hold to right)	Turns on transmitter with no modulation. Use test microphone connected to local mike receptacle to modulate transmitter.
LINE DISABLE	Normal (Not Actuated)	Transmitter can be operated by: 1. Squelch gate (repeater mode) 2. Remote control console over control line
	Actuated (hold to right)	Transmitter can be operated by: 1. XMIT switch to key transmitter 2. Local microphone to key and modulate transmitter 3. Squelch gate (repeat modes)



TOP VIEW  
(VIEW WITH TOP OFF OF CABINET)

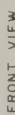
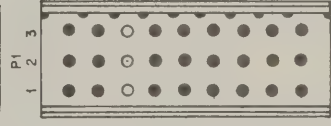
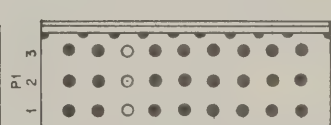
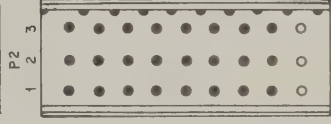
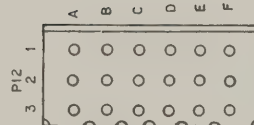
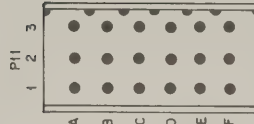
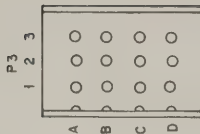
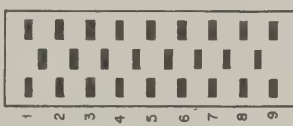
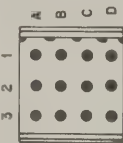


FRONT VIEW



DEPS-4019-0

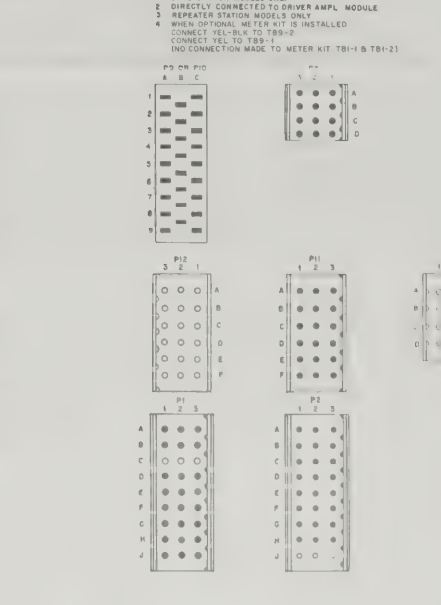
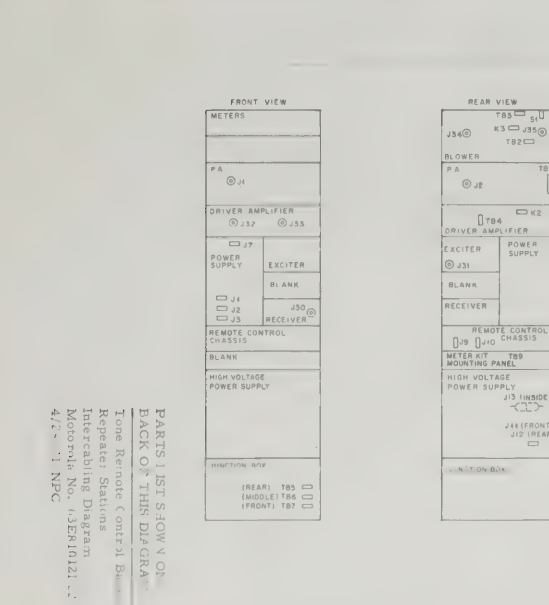
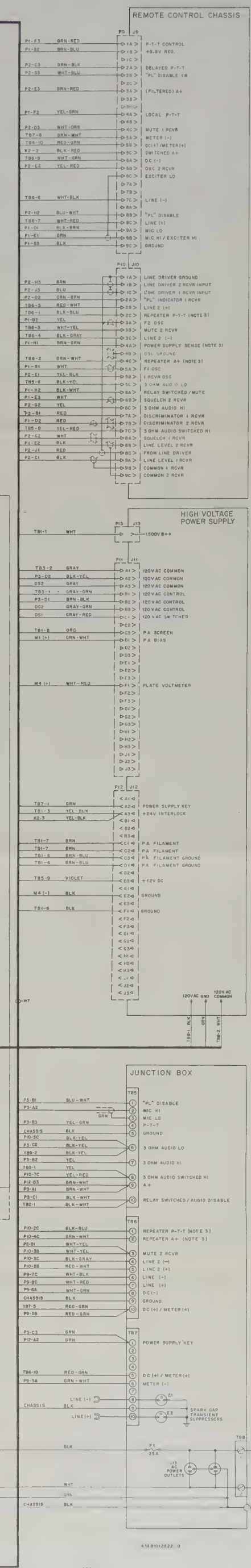
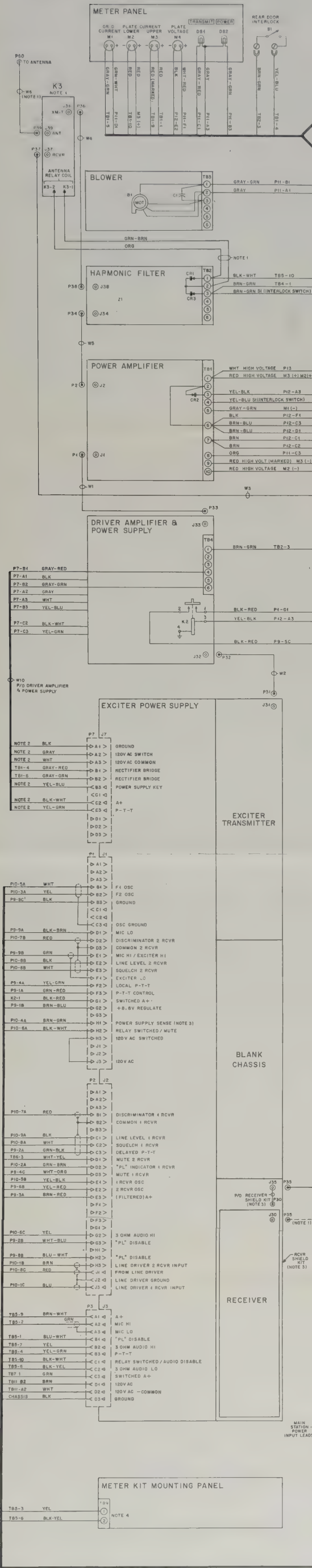




Tone Remote Control Base &  
Repeater Stations  
Intercabling Diagram  
Motorola No. 63E81012E22-O  
4/28/71-NPC









# CONTROL LINE MODE DESCRIPTION

NW	NO WIRE LINES - RECEIVED SIGNAL ACTIVATES TRANSMIT
2W	TWO WIRE LINES - AUDIO SIGNAL AND TONE CONTROL FUNCTION IMPOSED ON SAME LINES.

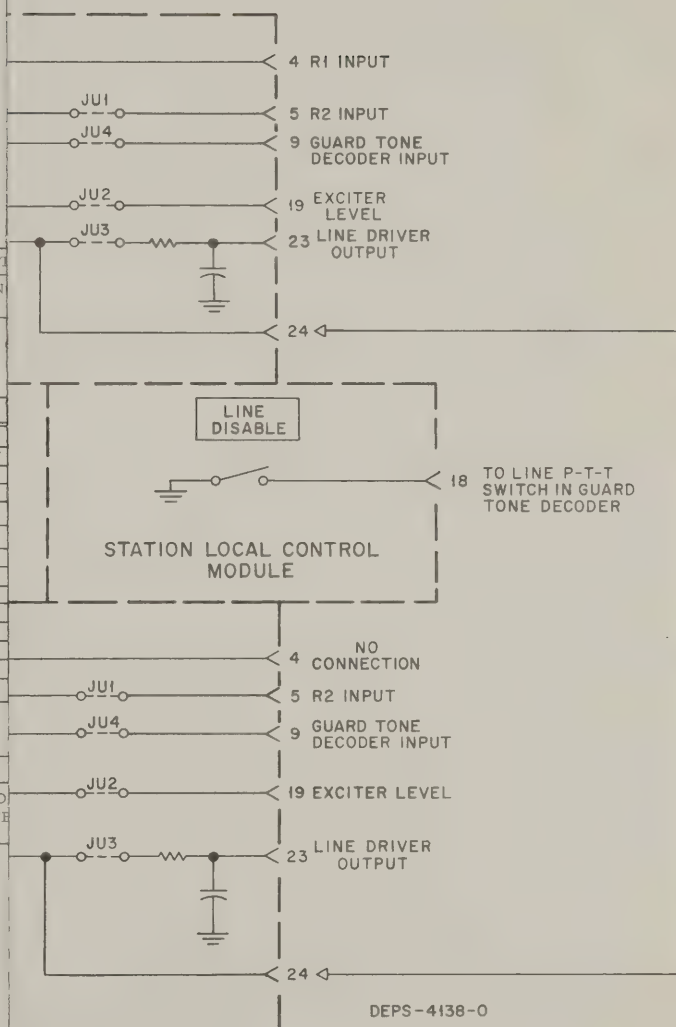
CHECK THAT JUMPERS ARE IN DESIRED POSITIONS FOR YOUR MODE

## INTERNAL CONNECTIONS

		JU1	JU2	JU3	JU4	JU5	JU6
NW	SQUELCH GATE (CARRIER)	OUT	IN	OUT	IN	IN	IN
	INTERCONNECT BOARD	IN	OUT	OUT	OUT	OUT	OUT
	TIME-OUT TIMER	OUT	IN	-	-	-	-
	SQUELCH GATE ("PL")	IN	OUT	OUT	IN	IN	IN
	STATION LOGIC	IN	-	-	-	-	-
2W	INTERCONNECT BOARD	IN	OUT	OUT	OUT	OUT	IN
	LINE DRIVER	OUT	IN	IN	IN	-	-
	STATION LOGIC	OUT	-	-	-	-	-
	GRD TONE	-	-	-	-	-	-
	FI DETECTOR ("PL")	OUT	IN	OUT	-	-	-
	SQUELCH GATE ("PL")	IN	OUT	OUT	IN	IN	IN
	TIME-OUT TIMER	OUT	IN	-	-	-	-
	FI DETECTOR (CARRIER)	OUT	IN	-	-	-	-
	SQUELCH GATE (CARRIER)	OUT	IN	OUT	IN	IN	IN

## EXTERNAL CONNECTIONS

NW	NONE
2W	CONNECT AUDIO/TONE CONTROL LINES TO TB6-6 AND TB6-7; CONNECT JUMPER FROM TB6-8 TO TB6-7; CONNECT THE JUMPER FROM TB6-8 TO TB6-6.



Audio and Control Line  
Connections Diagram  
Motorola No. PEPS-4142-O  
4/28/71-NPC

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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PARTS LIST

IMPORTANT  
USE ONLY THE FOLLOWING MOTOROLA  
PART NUMBERS WHEN ORDERING  
REPLACEMENT PARTS

TKN6497A Cable Kit (DC Carrier & "Private-Line"  
Controlled Base Station) PL-1252-O

CR1 CR2 CR3	40C82466H02	<u>SEMICONDUCTOR DEVICE,</u> diode;
	40C82466H02	silicon
	40C82466H02	silicon
E1 E2	80B83029H01	<u>ARRESTOR:</u>
	80B83029H01	electrical surge (spark gap)
P1 P2 P33 P34 P35 P36 P37	28B82398E02	<u>CONNECTOR, plug; coaxial:</u>
	28A808256	male; right angle; type "N"
	28K852527	male; type "N"
	28A808256	male; type "N"
	28K844859	male; right angle; type "N"
	28A808256	male; type "N"
	28K852527	male; type "N"
P30	28B82331G01	<u>CONNECTOR, plug; phono;</u> male
P1		<u>CONNECTOR, plug:</u>
		incl. 14C82337A11 BODY
		(27-hole); 29C82335A01 TER-
P2		MINAL contact, male;
		15B83934A01 SHELL
		incl. 14C82337A11 BODY
P3		(27-hole); 29C82335A01 TER-
		MINAL contact, male;
		15B83934A01 SHELL
P4		incl. 14C83783A05 BODY
		(12-hole); 29C82335A01 TER-
		MINAL, contact, male;
P5		15C83934A07 SHELL
		incl. 14C83833H01 BODY
		(27-hole); 29C82013H02 TER-
P10		MINAL contact, male;
		15B83096H01 SHELL
		incl. 14C83833H01 BODY
P11		(27-hole); 29C82013H02 TER-
		MINAL contact, male;
		15B83096H01 SHELL
P12		incl. 14C82337A07 BODY
		(18-hole, flanged),
		29C82335A01 TERMINAL,
TE9	31K481998	contact; male
		incl. 14C83783A01 BODY
		(18-hole); 29C82335A01 TER-
W1	30B83182A01	MINAL, contact, male
		<u>TERMINAL BOARD:</u>
		2 screw terminals; coded 1 & 2
W3	30B83182A01	<u>LINE, RF transmission;</u>
		CABLE, RF: coaxial; 43"
		length req'd
W4	30B852190	CABLE, RF: coaxial; 100"
		length req'd
		CABLE, RF: coaxial; 20"
W5	30B852190	length req'd
		CABLE, RF: coaxial; 12"
		length req'd
W7		<u>CABLE ASSEMBLY, special</u>
		purpose:
		miscellaneous leads, laced
NON-REFERENCED ITEM		
	TLN4503A	MOUNTING PANEL: meter kit

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
TLN4499A Blower		PL-1253-O
C1	8D83987A03	<u>CAPACITOR, fixed;</u> 2 uF ±10%; 600 V dc; oil
B1	SP7010062A	<u>BLOWER &amp; MOTOR:</u> Blower and Motor
NON-REFERENCED ITEM		
	35C82754G01	FILTER SCREEN

TLN4500A Meter Panel		PL-1254-O
DS1 DS2	65B82296H01 65B82296H02	<u>LIGHT, indicator: neon;</u> incl. lamp and RED lens incl. lamp and AMBER lens
M1 M2 M3	72D84865B03 72D84865B05 72D84865B05	<u>AMMETER, DC:</u> 500 uA 500 mA 500 mA
M4	72D84865B04	<u>VOLTMETER, DC:</u> 200 V; 100 mA
NON-REFERENCED ITEMS		
	61C84540C01 13B83155C01	PANE, glass GRILLE, speaker

TLN4501A Antenna Relay Kit		PL-1255-O
K3	80D84654C01	<u>RELAY, antenna:</u> 12 V; coaxial; spst
W6	30B852190	<u>LINE, RF transmission;</u> CABLE, RF: coaxial; 48" length req'd
P39 P50	28A828256 28A828256	<u>CONNECTOR, plug; coaxial:</u> male; type "N" male; type "N"

1V80701B81 Cable Assembly (p/o Driver Amplifier)		PL-1256-O
W2	30C82921H01	<u>LINE, RF transmission;</u> CABLE, RF: coaxial; 35" length req'd
P31 P32	28B82331G01 28B82331G01	<u>CONNECTOR, plug; coaxial;</u> male; miniature type male; miniature type

TLN4433A Cabinet Accessories		PL-1031-O
F1	65B83099A07	<u>FUSE, plug;</u> standard screw-base type; 20 A; 125 V
S1	40B84188A01	<u>SWITCH, sensitive;</u> door "interlock"; spst

TLN4498AV Junction Box PL-1267-O

J13	9A891865	<u>CONNECTOR, receptacle:</u> female dual unit; each section 3-contact
TB5 TB6 TB7 TB8	31B848187 31B848187 31B848187 31A50378	<u>TERMINAL BOARD:</u> 10 screw terminals 10 screw terminals 10 screw terminals dual screw terminals
W8	1V80781A84	<u>CABLE ASSEMBLY:</u> 3-conductor cable and a molded-on 3 cond male plug; length 9 ft.
XF1	9C83122C01	<u>FUSEHOLDER:</u> standard screw-base type

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
TLN1386A Filter & Panel		PL-1258-O
Z1	TLN6040A	<u>FILTER,</u> Harmonic Filter
CR1 CR3	40C82466H02 40C82466H02	<u>SEMICONDUCTOR DEVICE,</u> diode; silicon silicon



CONTROL LINE MODE DESCRIPTION

NW	NO WIRE LINES - RECEIVED SIGNAL ACTIVATES TRANSMITTER
2W	TWO WIRE LINES - AUDIO SIGNAL AND TONE CONTROL FUNCTIONS IMPOSED ON SAME LINES.

CHECK THAT JUMPERS ARE IN DESIRED POSITIONS FOR YOUR MODE OF OPERATION

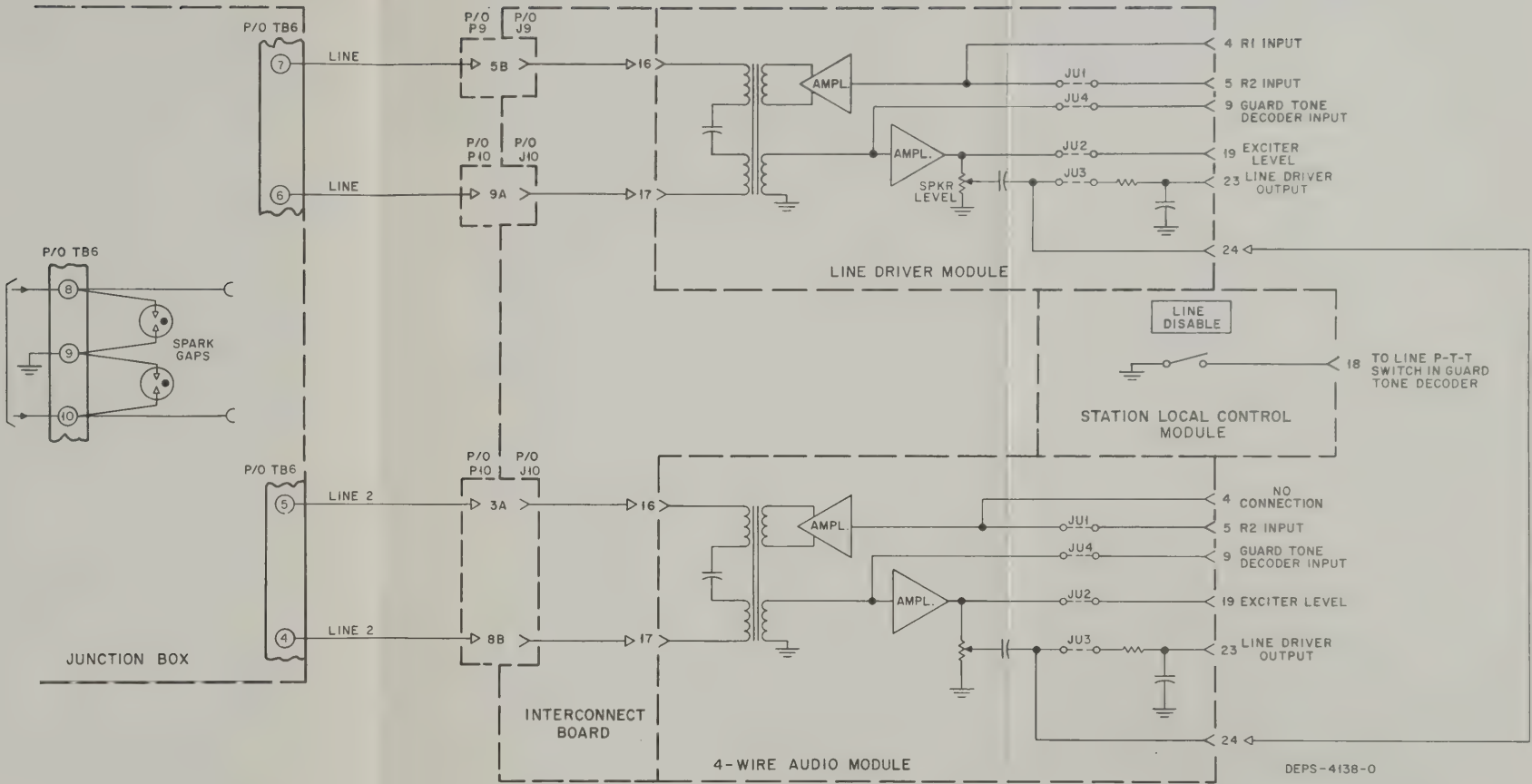
INTERNAL CONNECTIONS

		JU1	JU2	JU3	JU4	JU5	JU6	JU7	JU8	JU9
NW	SQUELCH GATE CARRIER	OUT	IN	OUT	IN	IN	IN	IN	IN	OUT
	INTERCONNECT BOARD	IN	OUT	OUT	OUT	OUT	OUT	-	-	-
	TIME-OUT TIMER	OUT	IN	-	-	-	-	-	-	-
	SQUELCH GATE ("PL")	IN	OUT	OUT	IN	IN	IN	IN	IN	OUT
2W	STATION LOGIC	IN	-	-	-	-	-	-	-	-
	INTERCONNECT BOARD	IN	OUT	OUT	OUT	OUT	IN	-	-	-
	LINE DRIVER	OUT	IN	IN	IN	-	-	-	-	-
	STATION LOGIC	OUT	-	-	-	-	-	-	-	-
2W	GRD TONE	-	-	-	-	-	-	-	-	-
	FI DETECTOR ("PL")	OUT	IN	OUT	-	-	-	-	-	-
	SQUELCH GATE ("PL")	IN	OUT	OUT	IN	IN	IN	OUT	OUT	IN
	TIME-OUT TIMER	OUT	IN	-	-	-	-	-	-	-
2W	FI DETECTOR CARRIER	OUT	IN	-	-	-	-	-	-	-
	SQUELCH GATE CARRIER	OUT	IN	OUT	IN	IN	IN	OUT	OUT	IN

EXTERNAL CONNECTIONS

NW	NONE
2W	CONNECT AUDIO/TONE CONTROL LINES TO TB6-6 AND TB6-7; CONNECT THE JUMPER FROM TB6-8 TO TB6-7; CONNECT THE JUMPER FROM TB6-10 TO TB6-6.

EPS-4137-O

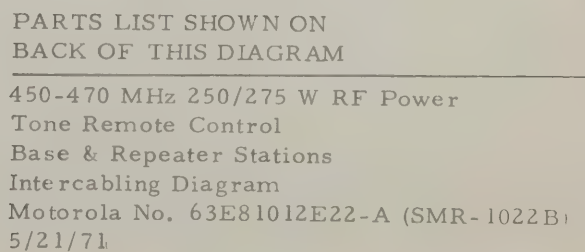


DEPS-4138-0

Audio and Control Line  
Connections Diagram  
Motorola No. PEPS-4142-O  
4/28/71-NPC



P10-5A	WHT		T81-7	BRN	< C1 >	PA FILAMENT
P10-3A	YEL		T81-7	BRN	< C2 >	PA FILAMENT
P9-5C	BLK		T81-6	BRN-BLU	< C3 >	PA FILAMENT GROUND
			T81-6	BRN-BLU	< D1 >	PA FILAMENT GROUND
					< D2 >	
			T85-9	VIOLET	< D3 >	+12V DC
					< E1 >	
			M4 (-)	BLK	< E2 >	GROUND
					< E3 >	
			T81-6	BLK	< F1 >	GROUND



REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
---------------------	---------------------	-------------

## PARTS LIST

### IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA  
PART NUMBERS WHEN ORDERING  
REPLACEMENT PARTS

TKN6497A Cable Kit (DC Carrier & "Private-Line"  
Controlled Base Station)

PL-1252-O

P1	40C82466H02	SEMICONDUCTOR DEVICE, diode;
P2	40C82466H02	silicon
CR1	40C82466H02	silicon
E1	80B83029H01	ARRESTOR:
E2	80B83029H01	electrical surge (spark gap)
	80B83029H01	electrical surge (spark gap)
P1	28B82398E02	CONNECTOR, plug; coaxial;
P2	28A808256	male; right angle; type "N"
P11	28K852527	male; type "N"
P14	28A808256	male; type "N"
P15	28K848850	male; right angle; type "N"
P16	28A808256	male; type "N"
P17	28K852527	male; type "N"
P18	28B82331G01	CONNECTOR, plug; phono;
		male
P1		CONNECTOR, plug;
		incl. 14C82337A11 BODY
		(27-hole); 29C82335A01 TER-
		MINAL contact, male;
		15B83934A01 SHELL
P2		incl. 14C82337A11 BODY
		(27-hole); 29C82335A01 TER-
		MINAL contact, male;
		15B83934A01 SHELL
P3		incl. 14C83783A05 BODY
		(12-hole); 29C82335A01 TER-
		MINAL, contact; male;
		15C83934A07 SHELL
P4		incl. 14C83833H01 BODY
		(27-hole); 29C82013H02 TER-
		MINAL contact, male;
		15B83096H01 SHELL
P5		incl. 14C83833H01 BODY
		(27-hole); 29C82013H02 TER-
		MINAL contact, male;
		15B83096H01 SHELL
P11		incl. 14C82337A07 BODY
		(18-hole, flanged).
		29C82335A01 TERMINAL,
		contact; male
P12		incl. 14C83783A01 BODY
		(18-hole); 29C82335A01 TER-
		MINAL, contact, male
TER1	31K481998	TERMINAL BOARD;
		2 screw terminals; coded 1 & 2
W1	30B83182A01	LINE, RF transmission;
		CABLE, RF; coaxial; 43"
		length req'd
W2	30B83182A01	CABLE, RF; coaxial; 100"
		length req'd
W3	30B852190	CABLE, RF; coaxial; 20"
		length req'd
W4	30B852190	CABLE, RF; coaxial; 12"
		length req'd
W7		CABLE ASSEMBLY, special
		purpose;
		miscellaneous leads, laced
NON-REFERENCED ITEM		
	TLN4503A	MOUNTING PANEL; meter kit

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
TLN4499A Blower		PL-1253-O
C1	8D83987A03	CAPACITOR, fixed;
		2 uF ±10%; 600 V dc; oil
B1	SP7010662A	BLOWER & MOTOR;
		Blower and Motor
NON-REFERENCED ITEM		
	35C82754G01	FILTER SCREEN

TLN4500A Meter Panel		PL-1254-O
D81	65B82296H01	LIGHT, indicator; neon;
D82	65B82296H02	incl. lamp and RED lens
		incl. lamp and AMBER lens
M1	72D84865B03	AMMETER, DC;
M2	72D84865B05	500 uA
M3	72D84865B05	500 mA
M4	72D84865B04	500 mA
VOLTMEETER, DC;		
		200 V; 100 mA
NON-REFERENCED ITEM		
	61C84540C01	PANE, glass
	13B83155C01	GRILLE, speaker

TLN4501A Antenna Relay Kit		PL-1255-O
K3	80D84654C01	RELAY, antenna;
		12 V; coaxial; spst
W6	30B852190	LINE, RF transmission;
		CABLE, RF; coaxial; 48"
		length req'd
P30	28A828256	CONNECTOR, plug; coaxial;
P30	28A828256	male; type "N"
		male; type "N"

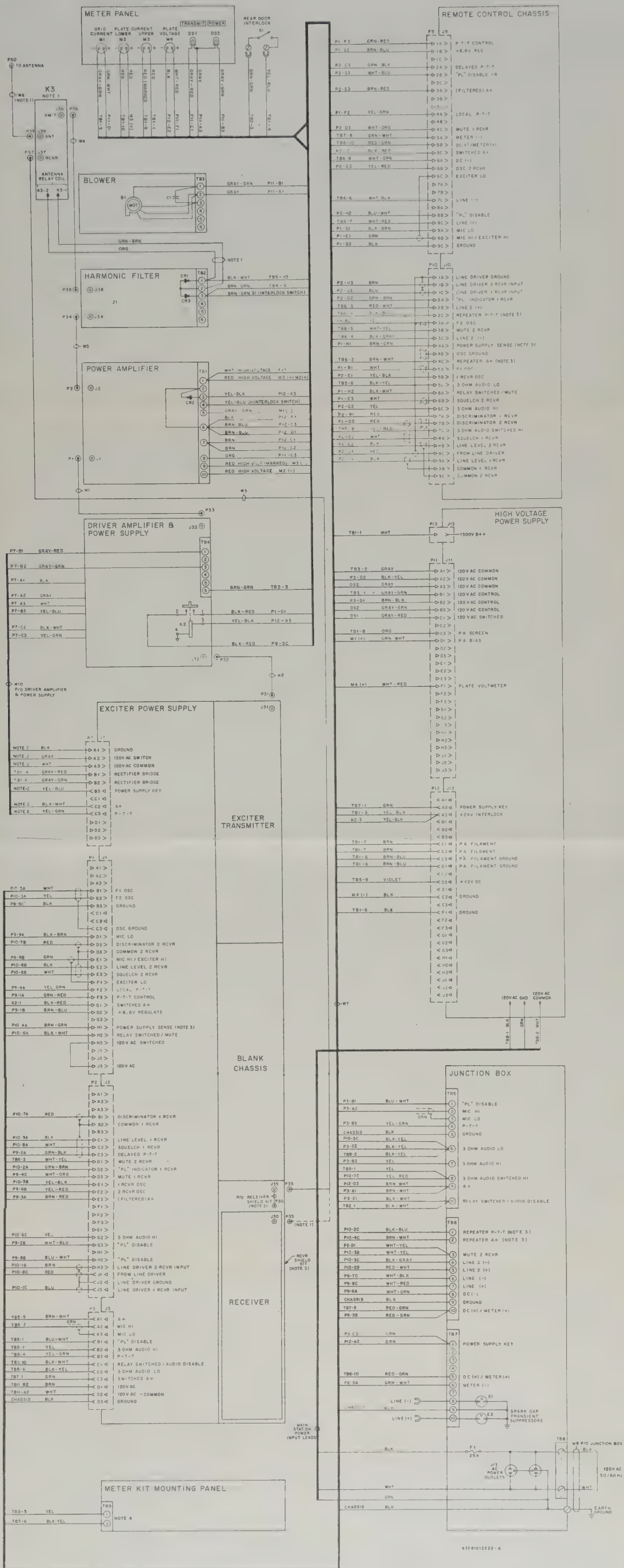
1V80701B81 Cable Assembly (p/o Driver Amplifier)		PL-1256-O
W2	30C82921H01	LINE, RF transmission;
		CABLE, RF; coaxial; 35"
		length req'd
P11	28B82331G01	CONNECTOR, plug; coaxial;
P12	28B82331G01	male; miniature type
		male; miniature type

TLN4433A Cabinet Accessories		PL-1031-O
F1	65B83099A07	FUSE, plug;
		standard screw-base type;
		20 A; 125 V
S1	40B84188A01	SWITCH, sensitive;
		door "interlock"; spst

TLN4498AV Junction Box		PL-1257-O
113	9A44865	CONNECTOR, receptacle;
		female dual unit; each section
		3-conduct
TERMINAL BOARD		
1B5	31B84815	10 screw terminals
1B6	31B84817	10 screw terminals
1B7	31B84818	10 screw terminals
1B8	31A5035	dual screw terminals
CABLE ASSEMBLY		
W4	1V80781A84	3-conductor cable and a
		molded-on 3 cond male plug;
		length 9 ft.
FUSEHOLDER		
X1	9C83122C01	standard screw-base type

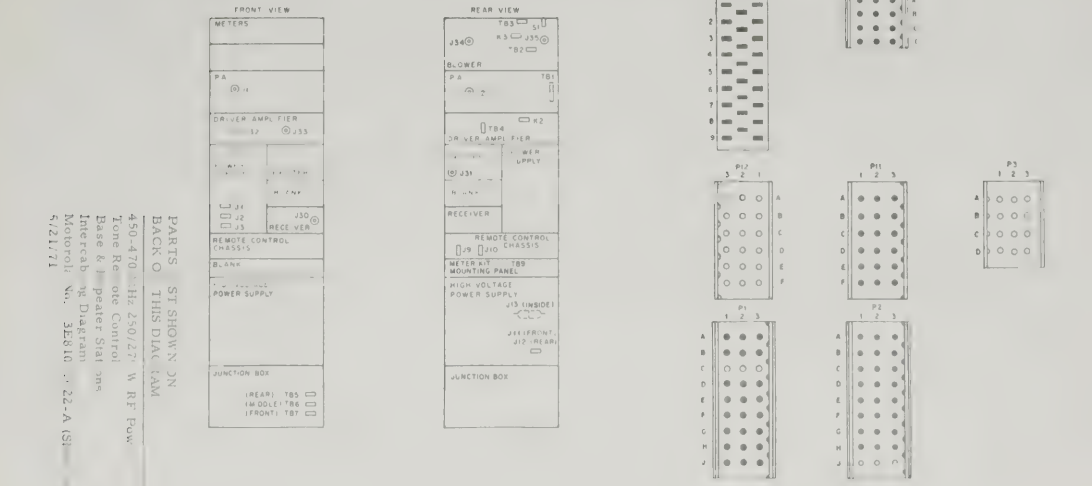
REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
TLN1386A Filter & Panel		PL-1258-O
Z1	TLN6040A	FILTER, Harmonic Filter
CR1	40C82466H02	SEMICONDUCTOR DEVICE, diode;
CR1	40C82466H02	silicon
		silicon





NOTE

- BASE STATION MODELS ONLY
- DIRECTLY CONNECTED TO DRIVER AMPL. MODULE
- REPEATER STATION MODELS ONLY
- WHEN OPTIONAL METER KIT IS INSTALLED, CONNECT YEL. BLK. TO T89-2, CONNECT YEL. TO T89-1, (NO CONNECTION MADE TO METER KIT T81-1 & T81-2)





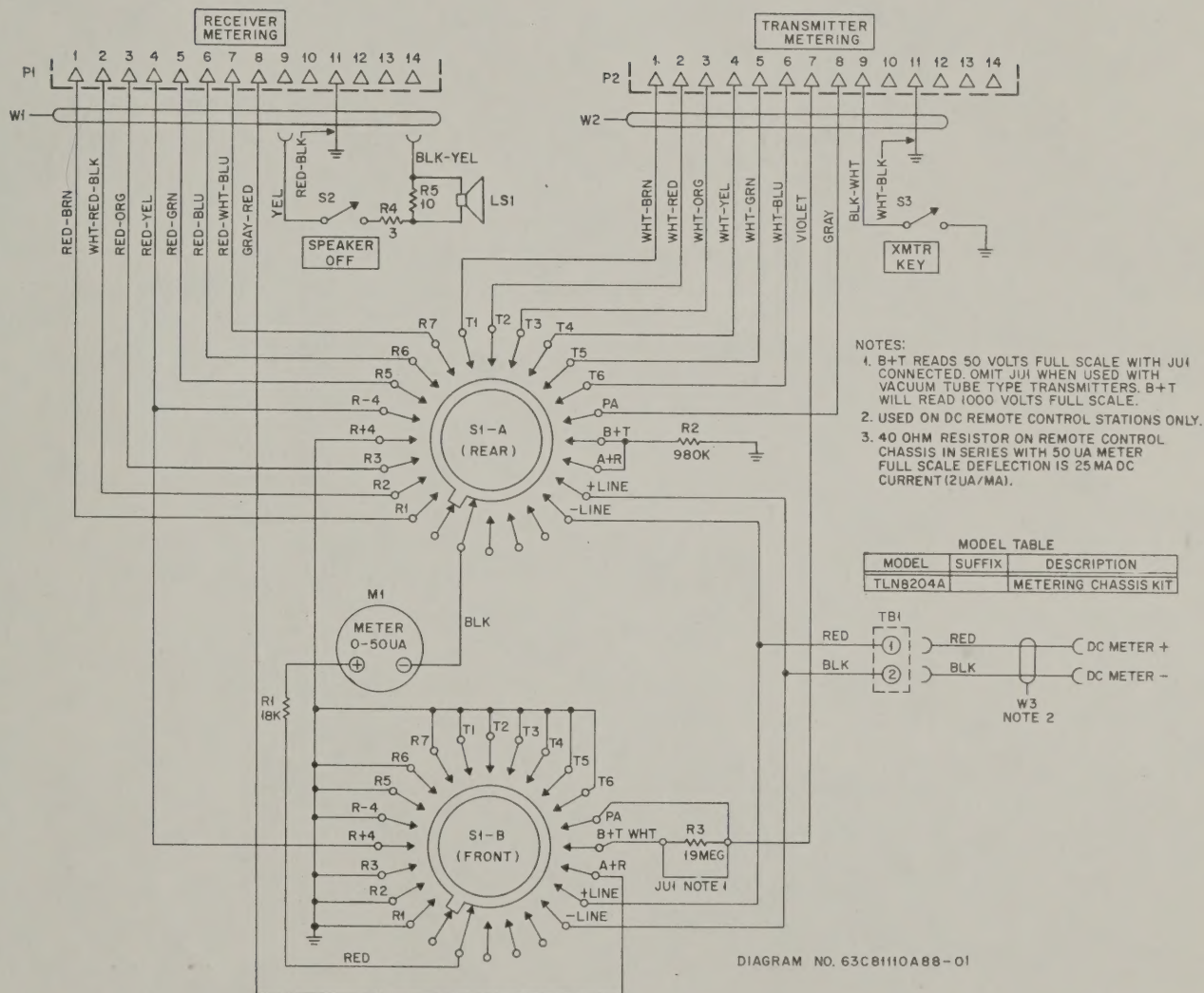






# METERING KIT

MODEL TLN8204A



PARTS LIST ON BACK



**MOTOROLA INC.**

ENGINEERING PUBLICATIONS

1301 E. ALGONQUIN ROAD

**Communications Division**

SCHAUMBURG, ILLINOIS 60172

METERING KIT

# PARTS LIST

for Diagram 63C81110A88-01

TLN8204A Metering Chassis

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
LS1	50B893245 or 50K801757	<u>LOUDSPEAKER, permanent magnet:</u> 2-1/2"; square; 3.2 ohms impedance; weatherproof 2-1/2" square; 3.2 ohms imp.
M1	72D83120C01	<u>AMMETER, DC:</u> 0-50 ua; res. 1820 ohms $\pm 10\%$
P1, 2	28B864669	<u>CONNECTOR, plug:</u> male; 12 contact; does not incl. 15A82798H01 SHELL, connector
R1	6K892470	<u>RESISTOR, fixed:</u> 18K $\pm 1\%$ ; 1/2 w
R2	6K811974	980K $\pm 2\%$ ; 1/2 w
R3	6D82475B64	19 meg $\pm 1\%$ ; 1/2 w
R4	17D82177B04	5 $\pm 10\%$ ; 5 w
R5	6R488022	10 $\pm 10\%$ ; 1 w
S1	40C83158C01	<u>SWITCH,</u> rotary; 2 section; c/o:
S1A		24 position; non-shorting
S1B		24 position; non-shorting
S2	40A11589	slide: spdt
S3	40A840806	slide: spdt (one position momentary)
TB1	31A863823	<u>TERMINAL BOARD:</u> 2 screw terminals
W1	1V80755A64	<u>CABLE ASSEMBLY, special purpose:</u> incl. P1 & miscellaneous leads
W2	1V80755A65	incl. P2 & miscellaneous leads
W3	1V80755A85	CABLE ASSEMBLY, special purpose